Water Quality Report: 2006
Quabbin Reservoir Watershed
Ware River Watershed

Photo: Quabbin Reservoir spillway. (Clif Read, January 2006)

May 18, 2007

Massachusetts Department of Conservation and Recreation
Office of Watershed Management
Division of Water Supply Protection

ABSTRACT

This report is a summary of water quality monitoring results from twenty-seven surface water stations established throughout the Quabbin Reservoir and Ware River watersheds. The Department of Conservation and Recreation, Division of Water Supply Protection (formerly the Metropolitan District Commission, Division of Watershed Management) is the state agency charged with the responsibility of managing Quabbin Reservoir and its surrounding natural resources in order to protect, preserve and enhance the environment of the Commonwealth and to assure the availability of pure water to future generations. As part of this effort, the Environmental Quality Section maintains a comprehensive water quality monitoring program to ensure that Quabbin Reservoir and its tributaries meet state water quality standards. As part of this task, the Environmental Quality Section performs the necessary field work, interprets water quality data and prepares reports of findings. This annual summary is intended to meet the needs of the decision makers, the concerned public and others whose decisions must reflect water quality considerations.

Quabbin Reservoir water quality in 2006 satisfied the requirements of the Filtration Avoidance Criteria established under the Environmental Protection Agency (EPA) Surface Water Treatment Rule. Monitoring of tributaries is a proactive measure aimed at identifying general trends and problem areas that may require additional investigation or corrective action. Compliance with state surface water quality standards among the tributaries varied with minor exceedances attributed to higher pollutant loads measured during storm events, wildlife impacts on water quality, and natural attributes of the landscape.

The appendix to this report includes summary information on mean daily flows of gaged tributaries, water quality data summary tables, and plots of reservoir water quality results. Some of the ancillary data presented in this report has been compiled with the help of outside agencies (*e.g.*, U.S. Geological Survey) and other workgroups within the DCR whose efforts have been acknowledged below.

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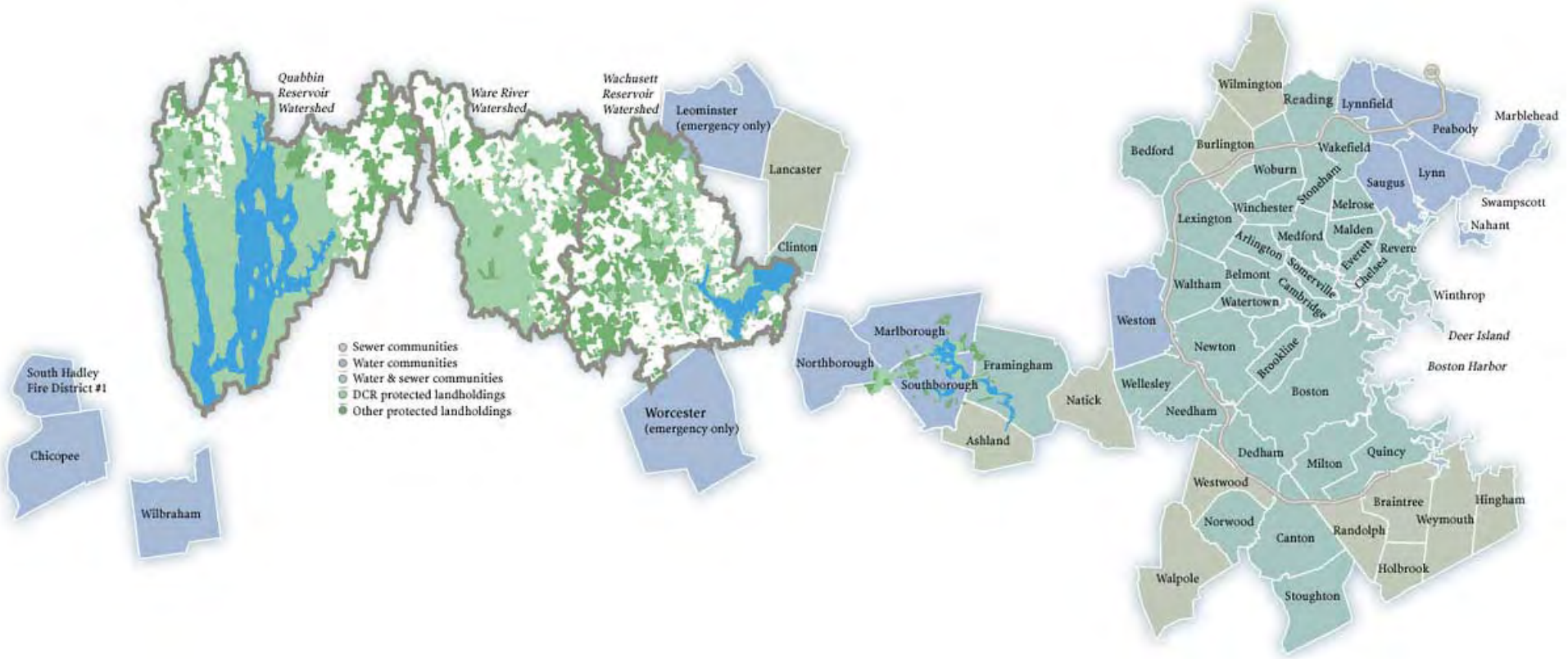


Source: MWRA, 2006

Figure 1. Quabbin Reservoir, Ware River, and Wachusett Reservoir Watershed System

1.0 INTRODUCTION

The Quabbin Reservoir, Ware River, and Wachusett Reservoir watershed system supplies drinking water to 50 communities, including 44 communities in the greater Boston and MetroWest region, three in western Massachusetts, and three as an emergency supply only. The Department of Conservation and Recreation (DCR) monitors and manages the watersheds to protect the drinking water source, while the Massachusetts Water Resources Authority (MWRA) manages the infrastructure and provides treatment. Both DCR and MWRA monitor the water quality to deliver safe drinking water. The watershed system and the MWRA service area are shown in **Figure 1**. This report summarizes the water quality monitoring that DCR performed in the Quabbin Reservoir and Ware River watersheds during 2006; a separate report has been prepared to summarize the monitoring performed during 2006 in the Wachusett Reservoir watershed.

The three drinking water sources, Quabbin Reservoir, Ware River and Wachusett Reservoir, are interconnected via the Quabbin Aqueduct. The largest of the three sources, Quabbin Reservoir, is capable of holding 412 billion gallons of water. Because of Quabbin's size, it required seven years after the damming of the Swift River in 1939 before the reservoir was completely filled. The reservoir surface is best described as two interconnected fingers; the larger eastern finger stretches about 18 miles in length and has a maximum width of roughly 4 miles. The western finger stretches about 11 miles in length and has a maximum width of roughly 1 mile. In total, the reservoir surface area covers 39 square miles (25,000 acres) and contains 118 miles of shoreline. **Table 1** summarizes some basic facts and figures about Quabbin Reservoir.

Quabbin Reservoir water transfers to Wachusett Reservoir via the Quabbin Aqueduct Intake at Shaft 12 typically account for more than half of the of MWRA's system supply. In 2006, transfers to Wachusett Reservoir totaled 34,130.00 million gallons. In the 131 days that transfers occurred, the Quabbin Aqueduct delivered an average of 260.53 MGD. A much smaller amount of water is transferred directly to three western Massachusetts communities on a daily basis, via the Chicopee Valley Aqueduct at Winsor Dam. In 2006, the CVA Aqueduct delivered on average 8.30 MGD of flow to the CVA communities. The reservoir maintained a normal operating level throughout 2006, continuing what has been steady state of recovery from below normal levels last experienced in early 2003. In 2006, the reservoir had a net storage loss of 17,963 MG and operating levels experienced a maximum fluctuation of 4.44 feet. Daily fluctuations in reservoir water level during the past two years are depicted in **Figure 2**.

Table 1. Quabbin Reservoir Facts and Figures

FACTS ABOUT THE RESERVOIR		FACTS ABOUT THE WATERSHED	
Capacity	412 Billion Gallons	**Watershed Area**	120,000 acres
Surface Area	24,000 acres	**Land Area**	96,000 acres
Length of Shore	118 miles	**DCR/OWM Land**	53,000 acres
Maximum Depth	150 feet	**% DCR/OWM Owned**	55%[1]
Mean Depth	45 feet	**Forested Lands**	83,235 acres
Surface Elevation, at Full Capacity	530 feet (Boston City Base)	**Wetlands**	5,289 acres
Year Construction Completed	1939	**Avg. Reservoir Gain From 1" of Precipitation**	1.6 Billion Gallons

Calendar Year:	***2006***	***2005***	***2004***
Maximum Reservoir Elevation (ft)	530.66 on January 19 & 20	530.35 on May 3 & 4	529.10 on May 19
Minimum Reservoir Elevation (ft)	526.22 on October 27	525.05 on January 1	523.93 on November 28
Total Diversions to Wachusett Reservoir	32,091.12 MG (131 days: 260.53 MGD)	37,560.44 MG (147 days: 255.51 MGD)	58,749.68 MG (271 days: 216.8 MGD)
Total Diversions to CVA	3,029.3 MG (365 days: 8.30 MGD)	3,195.5 MG (365 days: 8.75 MGD)	3,053.8 MG (366 days: 8.34 MGD)
Ware River Transfers	0 MG (No transfers in 2006)	2,992.1MG (14 days: 213.7 MGD)	5,335.8 MG (21 days: 254 MGD)
Spillway Discharges	51,951.12 MG (240 days: 216.5 MGD)	22,093.25 MG (169 days:130.7 MGD)	2,417.47 MG (71 days: 34 MGD)
Total Diversions to Swift River	63,361.12 MG (173.6 MGD)	32,673.25 MG (89.5 MGD)	11,302.47 MG (30.9 MGD)
Reservoir Ice Cover	Full reservoir ice cover not obtained.	≈100% cover: January 29 through April 10 (71 days).	≈100% cover: January 22 through April 2 (71 days).

Notes:

[1] Excludes reservoir surface area.

(….) Denotes number of days and average daily flow.

Source: DCR Civil Engineering Yield Data 2004-2006

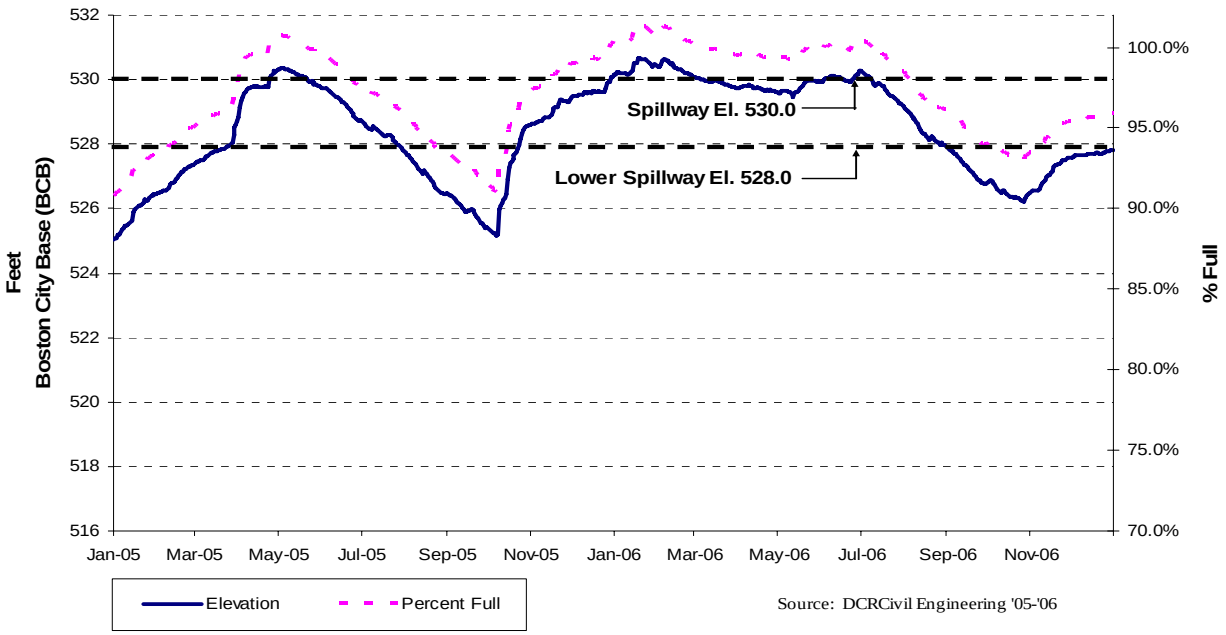
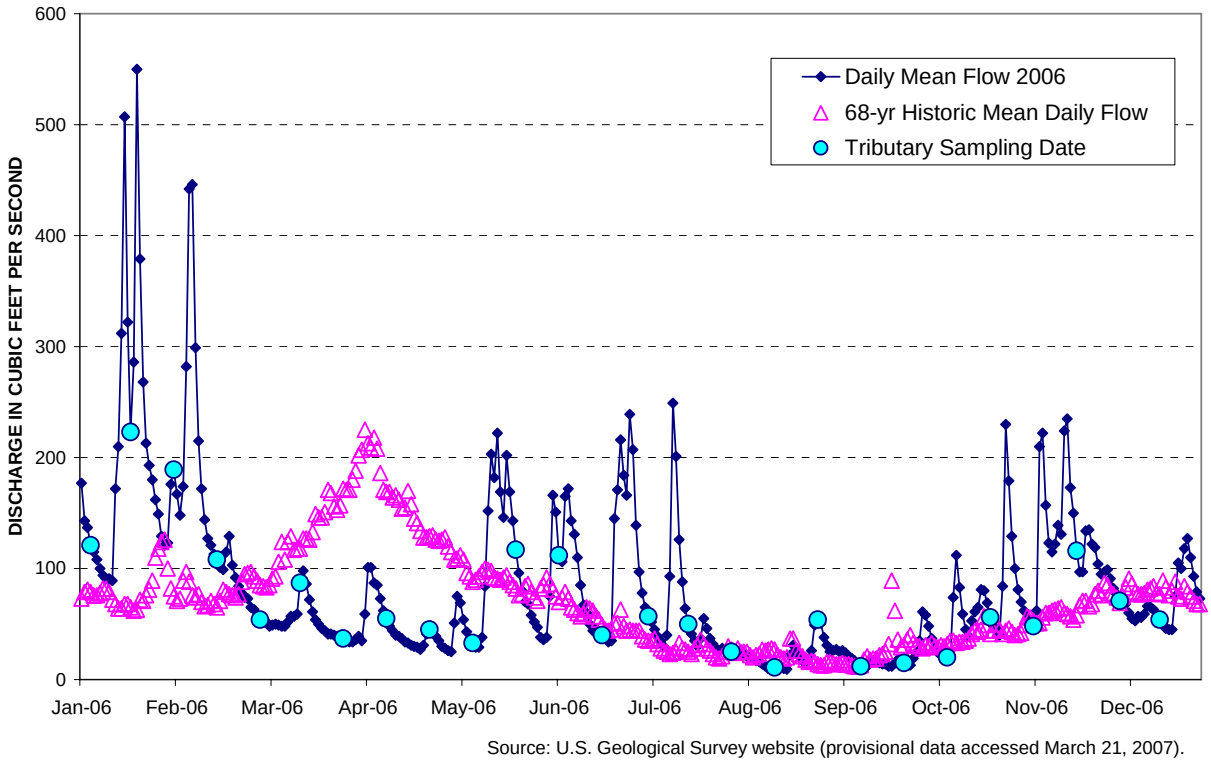


Figure 2. Quabbin Reservoir Daily Elevation, January 2005-December 2006

The Quabbin Reservoir watershed covers 187.5 square miles (120,000 acres) and contains practically all of the towns of New Salem and Petersham, considerable portions of Pelham, Shutesbury, and Wendell, and much smaller portions of Orange, Hardwick, Phillipston, Belchertown, Ware and Athol. More than 90% of the watershed lands are forested and the Department of Conservation and Recreation, Office of Watershed Management (DCR/OWM) owns and controls 53,000 acres (55%) for water supply protection purposes. Non-DCR owned lands can be characterized as sparsely populated and having limited agricultural sites, helping to maintain the pristine character often attributed to Quabbin Reservoir water.

The eastern portion of the watershed and much of the Petersham area is drained by the East Branch of the Swift River. This 43.6 square mile subwatershed area is the largest stream tributary to Quabbin Reservoir. The US Geological Survey, Water Resources Division, maintains stream gages on this and two other principal tributaries: 1) East Branch Swift River in Hardwick, 2) West Branch Swift River in Shutesbury, and 3) Ware River in Barre. In 2006, mean daily flows for the East Branch Swift River in Hardwick were measured at 84 cfs. No new period-of-station records were established in 2006. **Figure 3** depicts the hydrograph for the East Branch Swift River as measured at the horseshoe dam located at the outlet of Pottapaug Pond. As shown in **Figure 3**, the flow in the East Branch Swift River was above the 68-yr historic mean daily flow in January and February of 2006, when more precipitation fell as rain than as snow. It appears that the below-normal snowpack, along with below-normal precipitation, contributed to lower-than-usual flows in March and April.



Source: U.S. Geological Survey website (provisional data accessed March 21, 2007).

Figure 3. East Branch Swift River near Hardwick, MA, January-December 2006

The western part of the watershed is principally drained by the West Branch of the Swift River. This 14.10 square mile catchment area runs north-to-south between two well-defined, steeply sloped ranges. Steeply sloping ground, shallow soils and a narrow drainage area combine to generate runoff that is extremely quick and stream flows are typically characterized as flashy. In 2006, mean daily flows for the West Branch Swift River averaged 26 cfs. Mean daily flows set new period-of-station records (dating back to 1995) for monthly maximums in January and November, as well as monthly minimums in March and April.

Water from Ware River may supplement Quabbin Reservoir supplies by being diverted into the Quabbin Aqueduct at Shaft 8 in Barre and directed west towards Quabbin Reservoir via gravity flow. Under the authority granted by Chapter 375 of the Massachusetts Acts of 1926, the DCR is limited in the diversion of the water from the Ware River to a period from October 15 to June 15, and at no time is diversion allowed when the flow of the river at the diversion works is less than 85 MGD. Water from the Ware River enters the reservoir at Shaft 11A, located east of the baffle dams in Hardwick. In 2006, no water was transferred from Ware River to Quabbin Reservoir. Mean daily flows measured on the river at the intake works in Barre, Massachusetts, averaged 197 cfs (127 MGD). The mean daily flow in April 2006 set a new period-of-station record for monthly minimum value.

Based on USGS streamflow data analysis for index gage sites, watershed runoff for 2006 was above normal in January, February, June, July, October, and November, following above-average precipitation in January, May, June, and October. Watershed runoff was normal in August, September, and December, with normal and above-normal groundwater conditions compensating for lower than normal rainfall in September and December. Lower than normal watershed runoff in March and April can be attributed to the below-normal snowpack as well as the below-normal precipitation observed in those months.

Compared to the 68-year period-of-record for each respective month, the precipitation totals in January, May, June, and October of 2006 ranked among or near the top 20 percentile of monthly precipitation totals at the Belchertown monitoring station. No new records were set for monthly precipitation, although the total of 0.74 inch for March 2006 ranked as the second lowest observed in 68 years. April, July, and December of 2006 ranked among the lowest 20 percentile of total monthly precipitation. In 2006, the annual precipitation totaled 45.22 inches, close to the 68-year mean of 45.97 inches at the Belchertown station.

2.0 METHODOLOGY

This report presents water quality data results from routine sampling performed throughout the Quabbin Reservoir and Ware River watershed. There are a number of forces driving the need for a comprehensive water quality monitoring program, and they include:

1) To maintain long term water quality statistics for the significance in terms of public health protection that they provide.
2) To satisfy watershed control criteria applicable to the filtration avoidance requirements stipulated under the EPA's Surface Water Treatment Rule.
3) To identify streams and waterbodies that do not attain water quality standards where specific control measures may be initiated to eliminate or mitigate pollution sources.
4) To conduct proactive surveillance of water quality trends and potential trouble areas.

Sample Station Locations

The 27 surface water monitoring stations routinely monitored in 2006 include all major tributary inflows to Quabbin Reservoir, most minor tributaries flowing to the Quabbin Reservoir or Ware River, and selected locations within the Quabbin Reservoir. Of the 27 monitoring stations, 14 stations were located within the Quabbin Reservoir watershed, and 10 tributary stations were located in the Ware River watershed to characterize this supplemental source water supply. The remaining three sampling stations are located within the reservoir. The reservoir stations are monitored monthly during the months of April through December, with samples collected from several depths at each location. **Tables 2 and 3** present drainage area characteristics for the tributary surface water stations. The locations of the surface water monitoring stations are depicted in **Figures 4 and 5**.

Table 2. Quabbin Reservoir Tributaries

2006 Surface Water Monitoring Stations

			Basin Characteristics		
Tributary	**DCR Sample Site #**	**Sample Frequency[1]**	**Drainage Area (sq. miles)[2]**	**% Wetland Coverage[3]**	**% DCR/OWM Owned Land[4]**
East Br. of Swift River @ Rt. 32A	216	BW	30.3	10.4%	1.7%
West Br. of Swift River @ Rt. 202	211	BW	12.4	3.4%	33.0%
West Br. of Swift River (Sibley Branch)	211E	BW	3.85	1.2%	42.4%
West Br. of Swift River (New Boston Branch)	211F	BW	6.84	4.0%	44.7%
West Br. of Swift River @ (Cooleyviile Branch)	211G	BW	1.45	1.2%	51.0%
Middle Br. of Swift River @ Gate #30	213	BW	9.14	8.1%	22.7%
Middle Br. of Swift River @ Fay Road, New Salem	213A	BW	2.74	12.85%	<1%
Middle Br. of Swift River @ Elm Street, New Salem	213B	BW	4.76	4.62%	15.5%
Hop Brook Inside Gate 22	212	BW	4.52	2.5%	32.0%
Hop Brook @ Gate 22	212A	BW	0.94	2.32%	36.2%
Hop Brook @ Gate 24	212B	BW	3.39	2.68%	31.0%
East Br. of Fever Brook @ West Road	215	BW	4.15	11.5%	12.3%
Gates Brook @ mouth	Gates	BW	0.93	3.2%	100.0%
Boat Cove Brook @ mouth	BC	BW	0.15	<<1%	100.0%

Notes:

[1]BW = biweekly, or once every two weeks. Prior to May 1990 tributaries were monitored on a weekly basis.

[2]Source: Massachusetts Geographic Information System, Executive Office of Environmental Affairs; March 1990 revision.

[3]Source: DEP Wetland Conservancy Program (interpreted from 1:12000 Spring 1992-93 photos, April 1996 revision).

[4]Source: Automated by Massachusetts Geographic Information System & MDC, June 1997 revision.

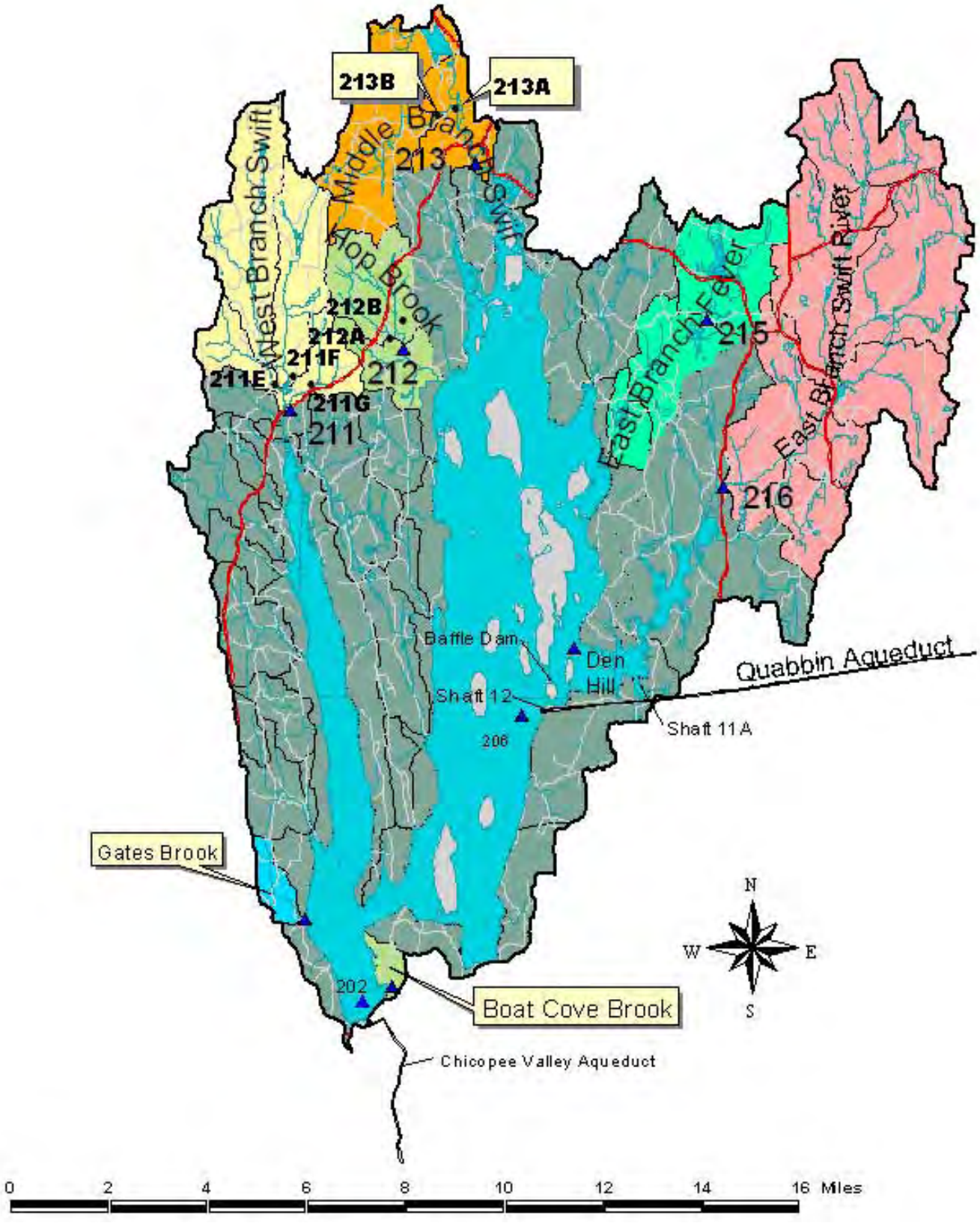


Figure 4. Hydrology, Subwatershed Delineation, and Water Quality Monitoring Sites for Calendar Year 2006 in the Quabbin Reservoir Watershed.

Table 3. Ware River Tributaries

2006 Surface Water Monitoring Stations

			Basin Characteristics		
Tributary	**DCR Sample Site #**	**Sample Frequency[1]**	**Drainage Area (sq. miles)[2]**	**% Wetland Coverage[3]**	**% DCR/OWM Owned Land[4]**
Ware River @ Shaft 8 (intake)	101	BW	96.5	13.2%	37.1%
Burnshirt & Canesto River @ Riverside Cemetery	103A	BW	31.15	10.5%	25.3%
West Branch Ware @ Brigham Road	107A	BW	16.64	15.1%	45%
East Branch Ware @ New Boston Rd.	108	BW	22.0	16.5%	12.3%
East Branch Ware @ Route 68	108A	BW	17.18	17.8%	10.2%
Cushing Pond Outlet @ Bemis Road	108B	BW	0.93	8.43%	52.8%
East Branch Ware River (Bickford) @ Lombard Rd	108C	BW	2.51	15.9%	0%
Asnacomet Pond @ outlet	116	BW	0.8	29.8	20.9
Comet Pond Outlet Tributary Near Clark Rd	116B	BW	1.05	27.6%	30.4%
Thayer Pond @ outlet	121A	BW	2.46	17.5%	23%

Notes:

[1]BW = biweekly, or once every two weeks. Prior to May 1990 tributaries were monitored on a monthly basis.

[2]Source: Massachusetts Geographic Information System, Executive Office of Environmental Affairs. March 1990 revision.

[3]Source: DEP Wetland Conservancy Program (interpreted from 1:12000 Spring 1992-93 photos, April 1996 revision).

[4]Source: Automated by Massachusetts Geographic Information System & MDC, June 1997 revision.

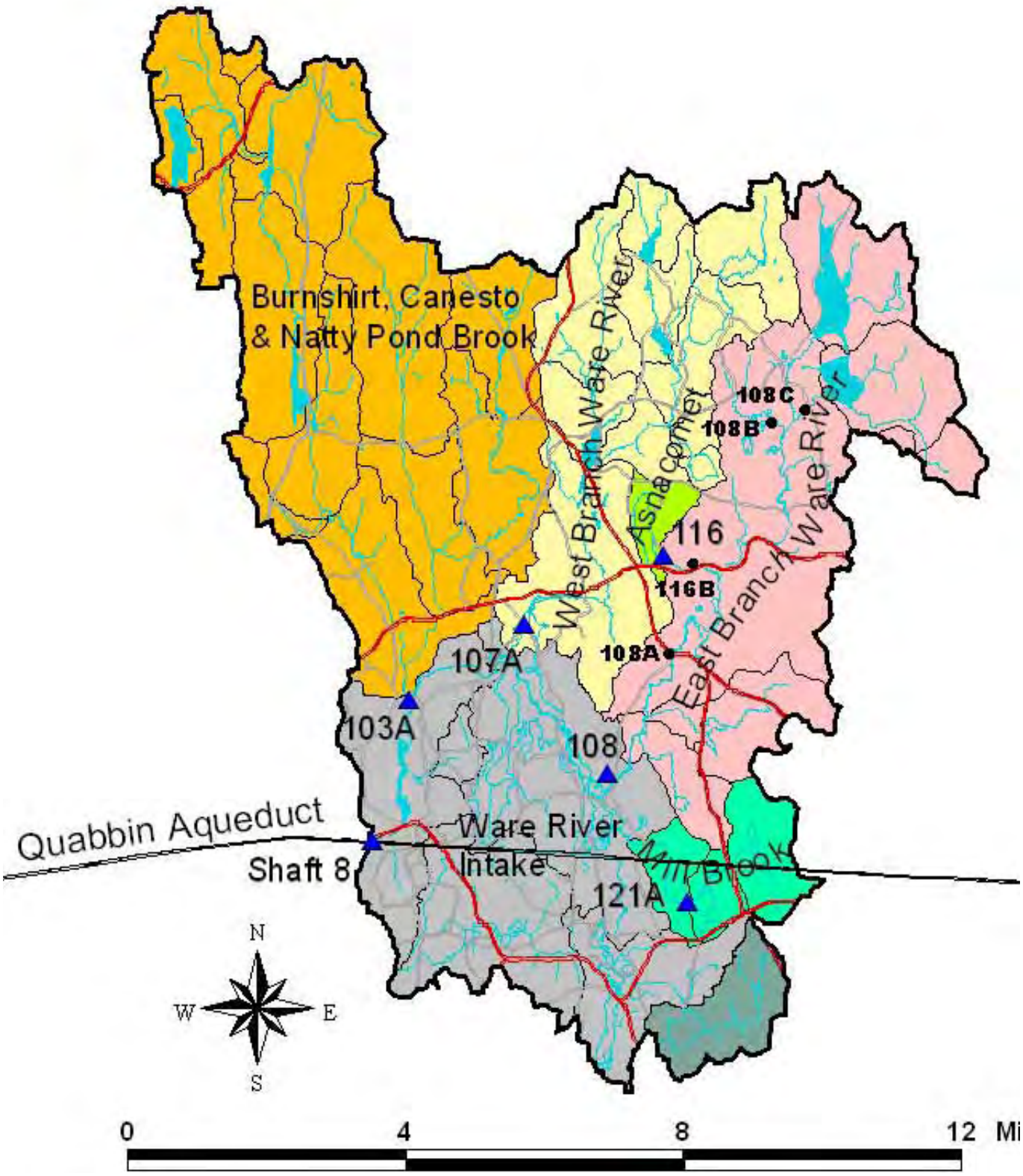


Figure 5. Hydrology, Subwatershed Delineation, and Water Quality Monitoring Sites for Calendar Year 2006 in the Ware River Watershed.

Data Collection

Each station is sampled biweekly (once every two weeks) with sampling runs alternating between the Quabbin Reservoir watershed and the Ware River watershed. Samples are collected by hand at the beginning of the work week (typically Tuesday) regardless of weather conditions. The frequency of sampling gives a more complete assessment of tributary health, capturing variations from seasonal flow conditions, as well as both dry and wet weather flows. Tributary stream temperature, dissolved oxygen, pH and specific conductance levels are determined in the field using a Eureka Multiprobe meter. Data are stored digitally using a Eureka Amphibian personal digital assistant (PDA) and transferred to a Microsoft Access database.

In 2006, Quabbin staff collected 2,561 source water samples. Of those samples, about one-quarter (694) were collected for microbial analysis, another one-quarter (669) were collected for physical properties, and the remaining 1,198 samples were collected for nutrient analysis. Over 5,500 individual analyses were performed on these samples, of which over one-third were nutrient analyses performed at the MWRA Central Laboratory at Deer Island. The remaining analyses were about 40 percent physiochemical parameters (1,438) and 60 percent bacterial analyses (2,082) performed by MWRA staff at Quabbin Laboratory. MWRA staff at Quabbin Laboratory also processed and analyzed 361 microbiological samples collected at the Winsor Disinfection Facility. In addition, nearly 2,400 physiochemical measurements were collected in the field by DCR staff using a Eureka Manta Multiprobe. All records are maintained in permanent bound books and in a digital format (Microsoft Access database).

Analytical Procedures

Water quality parameters routinely analyzed include temperature, pH, alkalinity, dissolved oxygen, specific conductance, turbidity, total coliform bacteria, fecal coliform bacteria and *Escherichia coli* (*E. coli*) bacteria. **Table 4** below lists the equipment and laboratory methods employed at Quabbin Laboratory.

Table 4. Quabbin Laboratory: Analytical and Field Methods

PARAMETER	**STANDARD METHOD (SM)[1]**
Turbidity	SM 2130 B
pH	Eureka Manta Multiparameter Probe
Alkalinity	SM 2320 B (low level)
Conductivity	Eureka Manta Multiparameter Probe
Temperature	Eureka Manta Multiparameter Probe
Dissolved Oxygen	Eureka Manta Multiparameter Probe
Total Coliform	SM 9222B, SM 9223B (Enzyme Substrate Procedure)
Fecal Coliform	SM 9222D
Escherichia coli (E. coli)	SM 9223B (Enzyme Substrate Procedure)

[1]Standard Methods for the Examination of Water and Wastewater, 20th Edition

Measurement Units

Chemical concentrations of constituents in solution or suspension are reported in milligrams per liter (mg/L) or micrograms per liter (μg/L). Milligrams per liter is a unit expressing the concentration of chemical constituents in solution as weight (milligrams) of solute per unit of volume of water (liter). One milligram per liter is equivalent to 1,000 micrograms per liter. Bacteria densities are reported as number of presumptive colony forming units per 100 milliliters of water (CFU/100 mL) or, for methods using the enzyme substrate procedure, most probable number (MPN/100 mL). The following abbreviations are used in this report:

CFS	Cubic feet per second
CFU	Colony forming unit
MGD	Million gallons per day
MPN	Most probable number
NTU	Nephelometric turbidity units
PPM	Parts per million (1 mg/L ≈ 1 PPM)
CU	Color units
TC	Total Coliform
THMFP	Trihalomethane formation potential
TKN	Total Kjeldahl nitrogen
μS/cm	Microsiemens per centimeter
μmhos/cm	Micromhos per centimeter (1 μmhos/cm = 1 μS/cm)

Monitoring Program Changes

Significant changes were made to the Quabbin tributary monitoring program in 2005 (See DCR, 2006b). The most significant change involved the establishment of twelve "EQ Assessment" sample sites where data were collected biweekly on bacteria levels, physiochemical parameters and nutrient levels. The monitoring at these special locations was conducted through 2006 to provide supportive information for Environmental Quality Assessments (sanitary surveys) being undertaken inside the Middle Branch Swift, Hop Brook, West Branch Swift and West Branch Ware Sanitary Subdistricts.

The tributary sampling program maintains five long-term, "core" sites located on primary tributaries inside of each watershed (Quabbin and Ware River). These core sites are important because they capture significant flow information and long term historical data will continue to be maintained. For core sites, Quabbin Reservoir watershed sites include West Branch Swift River at Route 202, Hop Brook inside Gate 22, Middle Branch Swift River at Gate 30, East Branch Fever Brook at West Road, and East Branch Swift River at Route 32A. Within the Ware River watershed, the core sites include Burnshirt River at Riverside Cemetery, West Branch

Ware River at Brigham Road, East Branch Ware River at New Boston Road, Thayer Pond outlet, and Ware River below the Shaft 8 intake.

3.0 RESULTS – SOURCE WATER QUALITY MONITORING

The U.S. EPA promulgated the Surface Water Treatment Rule (SWTR) in 1989 to ensure that public water supply systems using surface waters were providing safeguards against the contamination of water by viruses and other microbial pathogens such as *Giardia lamblia*. The regulations in effect require filtration by every surface water supplier unless strict source water quality criteria and watershed protection goals can be met. Source water quality criteria rely on a surrogate parameter, turbidity, and an indicator organism, fecal coliform bacteria, to provide a relative measure of the sanitary quality of the water. The SWTR standard for fecal coliform bacteria requires that no more than 10 percent of source water samples prior to disinfection over any six month period shall exceed 20 colonies per 100 mL.

The DCR and MWRA have maintained a waiver from the filtration requirement since 1989. To ensure compliance with the filtration waiver, the MWRA monitors daily the bacterial quality of Quabbin Reservoir water at a point prior to disinfection located inside the Ware Disinfection Facility. **Figure 6** depicts daily fecal coliform bacteria levels for 2006. In 2006, fecal coliform bacteria averaged less than one colony per 100 mL and were absent 78 percent of the time; the maximum level reached, 6 colonies per 100 mL, was measured on October 5.

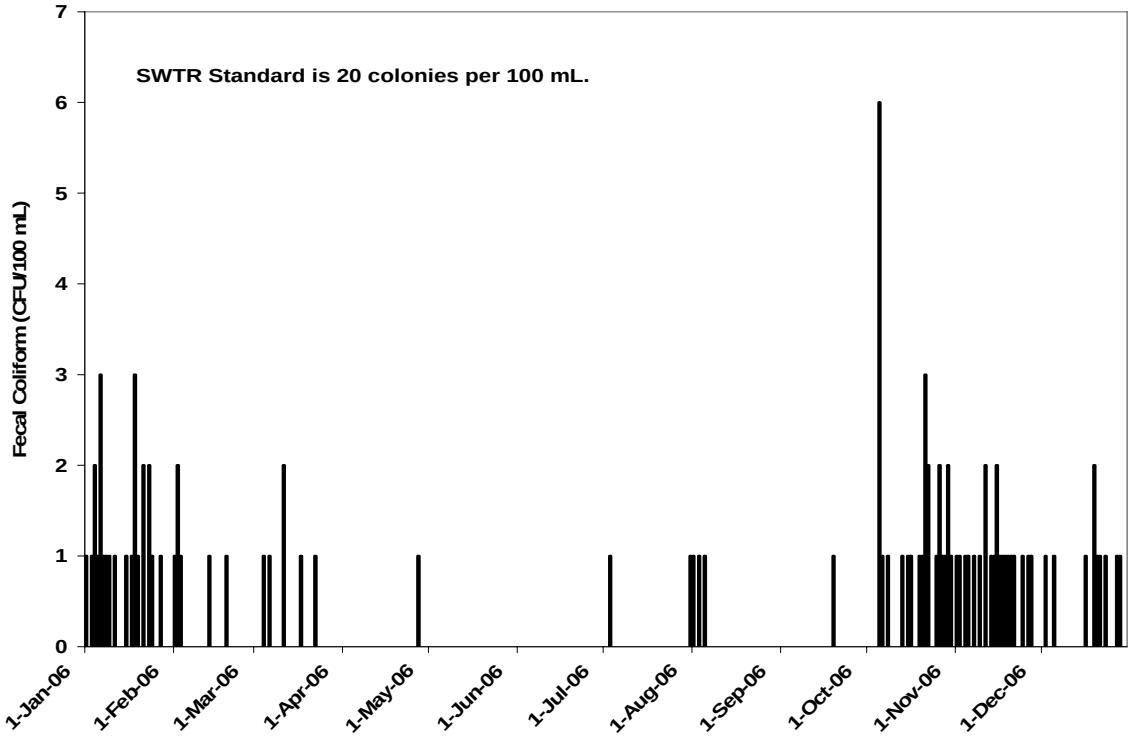


Figure 6. Fecal Coliform Bacteria Concentration prior to Disinfection, Quabbin Reservoir Source Water

For turbidity, the U.S. EPA SWTR standard is 5.0 NTU, while the Massachusetts DEP has adopted a more stringent performance standard of 1.0 NTU. MWRA monitors turbidity levels prior to disinfection using an on-line turbidity meter located inside the Ware Disinfection Facility. **Figure 7** depicts daily maximum and average turbidity levels for 2006 and includes a horizontal line marking the 1.0 NTU performance standard. For 2006, turbidity levels averaged 0.29 NTU, with occasional turbidity spikes observed in January, July, November, and December. The largest turbidity spikes of 1.28 and 0.78 NTU were observed on January 15 and November 16, respectively. The turbidity spike in January lasted less than three hours, while the November turbidity spike lasted about 15 minutes. Both spikes are believed to be related to storm events, with 2.4 inches of rainfall and mixed precipitation observed in the four days prior to the January 15th turbidity spike, and 0.79 inch of rain observed in the four days prior to the November 16th turbidity spike. In addition, the November 16th turbidity spike occurred during lake turnover, when the water column becomes isothermal and mixing between upper and lower depths can occur.

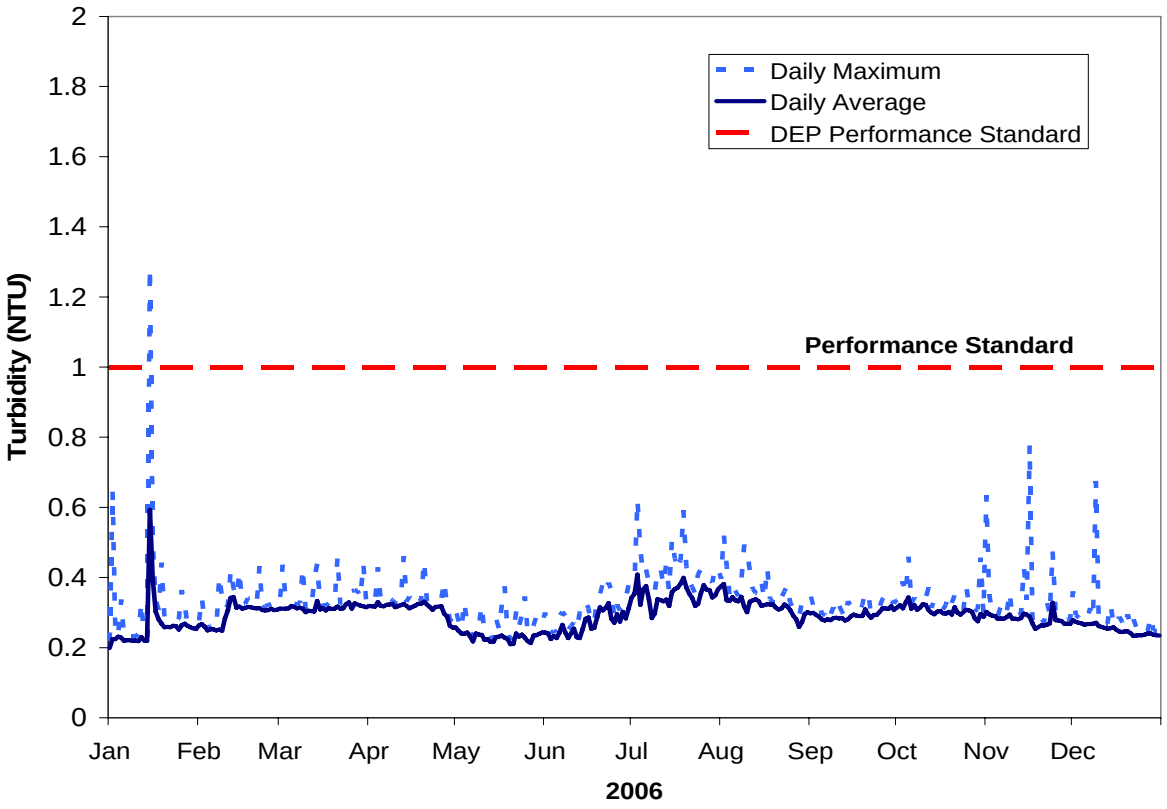


Figure 7. Quabbin Reservoir Source Water Turbidity (at Ware Disinfection Facility)

Giardia and *Cryptosporidium* monitoring on source water prior to disinfection is also conducted biweekly from a tap located inside the Winsor Power Station. These two waterborne pathogens are of concern because their cysts have a high resistance to chlorine, infectivity doses are low, and life-cycles are longer than conventional microbial pathogens. Both pathogens have been

linked to waterborne outbreaks of gastrointestional disorders such as diarrhea, cramping and nausea. Sample collection and analysis follows protocols established under EPA Method 1623. In 2006, twenty-six samples were collected and analyzed by MWRA staff. *Cryptosporidium* was not detected in any of the samples, while *Giardia* was detected at the detection limit of 2 cysts per 100 L in one sample, collected December 11, 2006. In that one sample, one cyst was recovered with amorphous (not consistent with a normal organism) structure. Additional pathogen sampling is scheduled to continue for the next year to comply with the Long Term 2 Surface Water Treatment Rule, which was promulgated in January 2006. This rule establishes levels of treatment for *Cryptosporidium* based on mean levels detected in monitoring results.

3.1 RESULTS – RESERVOIR MONITORING

Reservoir water quality data collected by the DCR documents consistently reliable source water quality that fully meets the stringent source water quality criteria stipulated under the Surface Water Treatment Rule. Water quality data are collected monthly except during periods of adverse weather and ice conditions in the winter. Three sampling stations that were routinely sampled in 2006 are profiled in **Table 5**. **Figure 4** may be referenced for the specific locations of each sample site. It should be noted that the Shaft 12 sampling location was moved on June 14, 2006, to the west of its previous location, to ensure that sampling occurs within the former Quabbin Lake basin.

Table 5. 2006 Quabbin Reservoir Water Quality Monitoring Sites

Site (Site ID)	***Location***	***Latitude Longitude***	***Approximate Bottom Depth***
Winsor Dam (QR202)	Quabbin Reservoir west arm, off shore of Winsor Dam along former Swift River riverbed.	N 42°17’15” W 72°20’59”	40.8 meters
Shaft 12 (QR206)	Quabbin Reservoir at site of former Quabbin Lake, off shore of Shaft 12.	N 42°22’10” W 72°17’5”	35.5 meters
Den Hill (QR10)	Quabbin Reservoir eastern basin, north of Den Hill	N 42°23’23” W 72°15’57”	19.0 meters

Reservoir water inside the three distinct reservoir basins is sampled at depth monthly between April and December (weather permitting). Water samples are collected at depth with the aide of a kemmerer bottle and samples are analyzed at Quabbin Laboratory for turbidity, pH, and alkalinity. Samples for total and fecal coliform bacteria are taken at the surface, mid-epilimnion depth (typically 5-7 meters) and at the respective water supply intake depth. Physiochemical

grab samples are taken from mid-epilimnion and mid-hypolimnion during times of thermal stratification, and near the top and bottom during periods of isothermy and mixing. Wind, weather, reservoir conditions and air temperature are recorded on each survey. A standard 20-centimeter diameter, black-and-white Secchi disk is used to measure transparency.

Water column profiles of temperature, pH, dissolved oxygen, and specific conductance are measured in-situ using a Eureka Manta Multiprobe. Readings are taken every meter during times of thermal stratification and mixing, and every three meters during periods of isothermy. Field data is stored digitally using a PDA (personal digital assistant) and transferred to a computer database maintained by the Environmental Quality Section.

Quarterly sampling for nutrients and phytoplankton was performed at the onset of thermal stratification (May), in the middle of the stratification period (late July), near the end of the stratification period (October), and during a winter period of isothermy (December). The MWRA Central Laboratory provided analytical support for the measurement of total phosphorus, total Kjeldahl nitrogen, nitrate, ammonia, UV_{254} absorbance and silica.

Table 6 presents an overview of reservoir water quality conditions at three stations routinely monitored in 2006. The complete data for individual stations is included in the Appendix. Provided below is a brief discussion of selected monitoring parameters and their significance to reservoir water quality conditions.

Table 6. General Water Chemistry, 2006 Quabbin Reservoir Monitoring Stations.

	pH (Field)	**Turbidity**	**Dissolved Oxygen**	**Secchi Disk Transparency**	**Total Coliform Bacteria**	**Fecal Coliform Bacteria**
Reservoir Station (Site ID)	Range (units)	Range (NTU)	Range (% Saturation)	Range (meters)	Range (CFU/100mL)	Range (CFU/100mL)
Winsor Dam (QR202)	5.5-7.0	0.17-0.37	58-124	8.7-12.6	0-3280	0-1
Shaft 12 (QR206)	5.5-7.7	0.18-0.61	42-126	8.3-12.2	0-504	0-19
Den Hill (QR10)	5.6-7.3	0.25-1.01	20-116	4.0-8.7	0-1550	0-2

Temperature

The thermal stratification that occurs in the reservoir has a profound impact on many of the parameters monitored across the reservoir profile. The temporal zones that develop within the reservoir during the warmer months of spring and summer, known as the epilimnion, metalimnion and hypolimnion (listed in order from top to bottom), have distinct thermal, water

flow and water quality characteristics. Waters of the epilimnion are warm and well mixed by wind driven currents, and the epilimnion may become susceptible to algal growth due to the availability of sunlight and entrapped nutrients introduced to the partitioned layer of surface water. Within the metalimnion the thermal and water quality transition occurs between the warmer surface waters and colder, deep waters. The much deeper hypolimnic waters may become stagnant and serve as a sink for decaying matter and sediments that settle out from the upper layers of warmer water. Each year the reservoir is completely mixed due the settling of cooler surface waters in the fall and following springtime ice-out when an isothermal water column is easily mixed by winds. Profile data collected at Station 202 (Winsor Dam) is shown in **Figure 8** to graphically portray the thermal mixing and transition that occurs between fully mixed, isothermal to fully stratified conditions. Fall turnover probably occurred about mid- to late November, based on the temperature profiles for Station 202 and Station 206 (Shaft 12). The water column at Station 206 was nearly completely mixed by November 16th, while at Station 202, where the water is 4 to 5 meters deeper, the water column was not fully mixed until December 14th.

Dissolved Oxygen

Oxygen is essential to the survival of aquatic life (trout need a minimum of 5.0 mg/L or 44 percent saturation at 10°C). Available oxygen also plays an important role in preventing the leaching of potentially harmful metals trapped among the bottom sediments. Dissolved oxygen, or more specifically the loss of oxygen from the hypolimnion, is used is as one index to characterize the trophic state of a lake. Because re-aeration factors such as wind driven turbulence, reservoir currents, and atmospheric diffusion diminish with depth, dissolved oxygen concentrations typically decrease with depth. Moreover, the sinking of decaying organic debris into the hypolimnion can be a major source of oxygen depletion in highly productive lakes because of the respiration requirements of microbial populations responsible for the decomposition of organic wastes. Hypolimnic oxygen reserves established in the spring are not replenished until the late fall when cooling surface waters ultimately settle and re-mix the reservoir. In 2006, minimum levels of oxygen reached in the hypolimnion ranged from a low of 20 percent saturation at the Den Hill station to 58 percent saturation at the bottom depths at Station 202. Depletion levels were most pronounced in the latter stages of stratification (September and October), but dissolved oxygen at the two deep water stations never dipped below 5.0 mg/L. The seasonal development and breakdown of lake stratification is depicted in temperature and dissolved oxygen profiles shown in **Figure 8**.

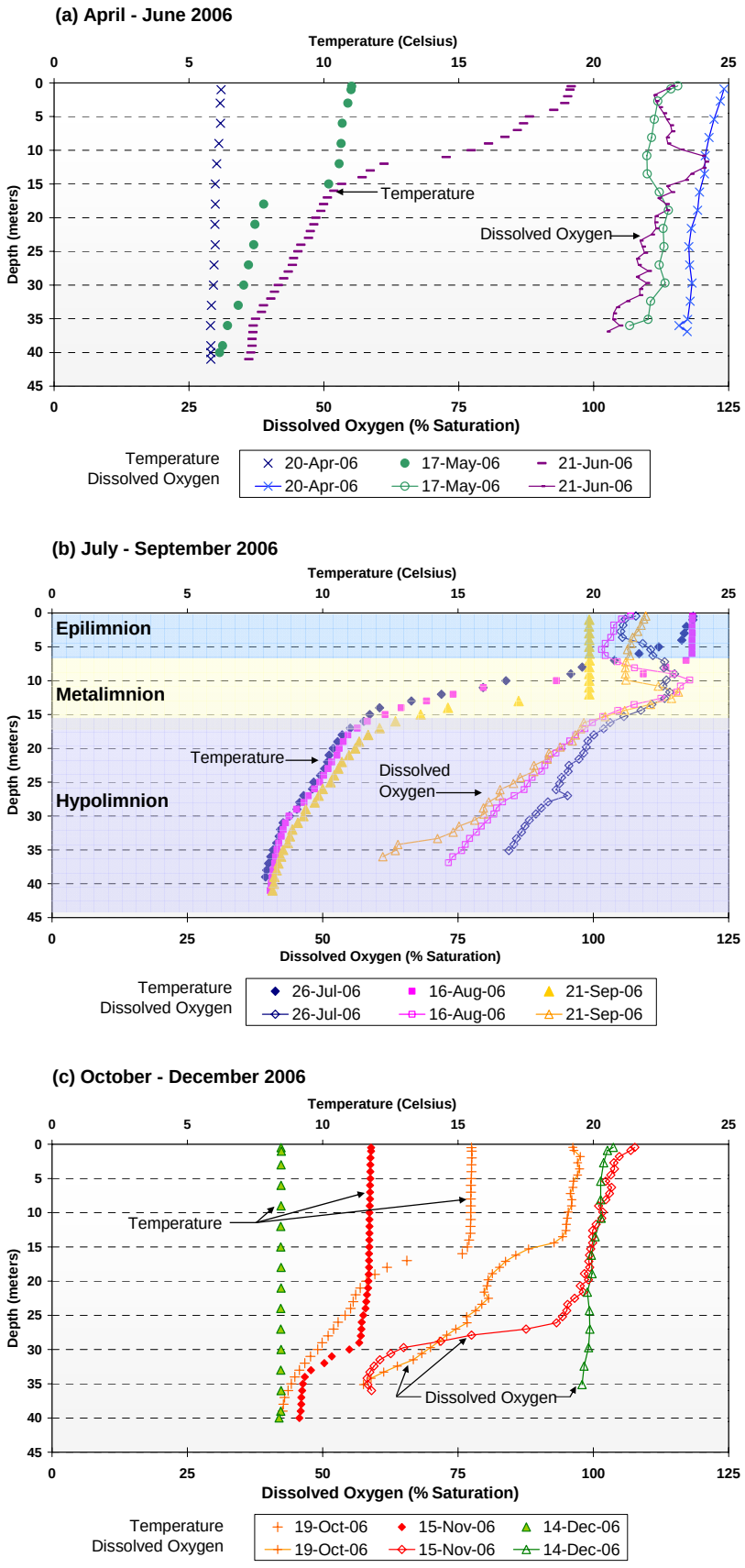


Figure 8. Temperature and Dissolved Oxygen Profiles at Quabbin Reservoir Site 202.

Turbidity

Reservoir turbidity levels are historically very low and stable, reflective of the low productivity of the reservoir. In-reservoir turbidity levels monitored in 2006 ranged from 0.17 to 1.01 NTU. The highest turbidity measurement occurred in the deep sampling station at Den Hill, on September 21st, and may have resulted from a recent storm, with 0.22 inch rainfall recorded at Barre Falls Dam on the previous morning. Other typical causes of turbidity in the reservoir include algal blooms or shoreline erosion. From time to time, algae blooms may impart color and suspended organic particulates that will elevate levels of turbidity. Near-shore areas are also prone to elevated turbidity levels due to the action of waves that may re-suspend shoreline sediment and deposits.

pH and Alkalinity

Three processes principally reflected in reservoir pH and alkalinity dynamics are 1) direct acidic inputs (*i.e.*, rainfall, dry deposition), 2) biological respiration and 3) algal photosynthesis. The input of acid in the form of direct precipitation will consume alkalinity available in the water and reduce pH levels. Reservoir pH is an important consideration because levels below 6 increase the solubility of persistent heavy metals such as mercury, allowing the metal to be incorporated into the water system and thus more likely to accumulate in the tissue of living organisms such as fish. As a result most northeastern lakes like Quabbin Reservoir have posted fish consumption advisories that suggest limiting the quantity of fish consumed because of the presence of higher levels of mercury in the fish. Quabbin Reservoir water is slightly acidic with a pH level that averaged 6.34 across the three stations monitored in 2006.

Alkalinity serves as a water body's principal defense by neutralizing the effects of pH. Both pH and alkalinity have a long-term record of stability in the Quabbin Reservoir, but levels will fluctuate due to reservoir dynamics. Fluctuations may be caused through respiration by organisms as oxygen is consumed and carbon dioxide is released. The result will be an increase in alkalinity due to the input of carbon to the water. Photosynthetic activity in the epilimnion and metalimnion can decrease alkalinity and increase pH due to the consumption of free carbon dioxide and bicarbonate. Reservoir alkalinity is low and averaged 5.31 mg/L as Ca CO_3 across the three reservoir stations with very little variation observed at depth.

Secchi Disk Transparency

Quabbin reservoir water has excellent clarity and visibility as evidenced by maximum Secchi disk readings that approach 13 meters. Transparency is determined as the depth below the surface at which a 20-centimeter, black-and-white disk becomes indistinguishable to the naked eye. While sensitive to weather and reservoir conditions at the time of sampling, transparency can be greatly influenced by the level of phytoplankton activity. Historically, reservoir

transparency measurements are consistent with the pattern of phytoplankton dynamics (Worden, 2000). In 2006, transparency was measured at a maximum of 12.6 meters at Site 202 on July 26.

Transparency at the Den Hill station is characteristically much lower, typically reflecting the contribution of large, nearby river inputs of the East Branch Swift and the Ware River (when diverting). The contribution of the East Branch Swift River, estimated to contribute as much as 9 to 16 percent of the annual flow to the reservoir, is a significant source of color that reduces transparency. In 2006, transparency was measured at a minimum of 4.0 meters at Den Hill on April 20. This low transparency may have been related more to the choppy water surface conditions on the sampling date than to any large river inflows, since the East Branch Swift River flow was lower than usual in Spring 2006, and no diversions of Ware River were undertaken at all in 2006. Monthly transparency measurements and weather observations are noted in **Tables 7, 8,** and **9**.

Table 7. Transparency Measurements and Weather and Water Surface Observations in 2006, Quabbin Reservoir Site 202 (Winsor Dam).

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 20, 2006	10.1	Green	Clear, 20°C (68°F), N wind 6 mph, 6” waves.
May 17, 2006	10.2	Green	Partly cloudy, 22°C (72°F), S wind 3 mph, slight ripple.
June 21, 2006	8.7	Light blue-green	Partly cloudy, 22°C (72°F), N wind 2 mph, slight ripple.
July 26, 2006	12.6	Light blue-green	Fair, 26°C (79°F), SW wind 1 mph, calm water surface.
August 16, 2006	11.3	Light blue-green	Fair, 25°C (77°F), WNW wind 1 mph, calm water surface.
September 21, 2006	11.4	Light blue-green	Fair, 12°C (54°F), N wind 5 mph, 8” waves.
October 19, 2006	10.8	Light blue-green	Fair, 13°C (55°F), no wind, calm water surface.
November 15, 2006	11.0	Slate green	Overcast, 13°C (55°F), SW wind 0-2 mph, very light waves.
December 14, 2006	10.6	Light blue-green	Fog, 9°C (48°F), SW wind 2-3 mph, slight ripple.

Table 8. Transparency Measurements and Weather and Water Surface Observations in 2006, Quabbin Reservoir Site 206 (Shaft 12).

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 20, 2006	8.3	----	Clear, 23°C (73°F), N wind 6 mph, 4" waves.
May 17, 2006	10.1	Green	Partly sunny, 22°C (72°F), S wind 5 mph, 6" ripple.
June 21, 2006	9.1	Light blue-green	Partly cloudy, 22°C (72°F), N wind 1 mph, calm water surface.
July 26, 2006	12.2	Light blue-green	Fair, 28°C (82°F), S wind 2 mph, slight ripple.
August 16, 2006	10.8	Light blue-green	Fair, 26°C (79°F),WSW wind 1-2 mph, calm water surface.
September 21, 2006	10.0	Light blue-green	Fair, 14°C (57°F), N wind 5 mph, 8" waves.
October 19, 2006	9.1	Light blue-green	Cloudy, 13°C (55°F), S wind 1-3 mph, 6" waves.
November 15, 2006	10.2	Dark slate green	Overcast, 13°C (55°F), S wind 0-2 mph, light waves.
December 14, 2006	11.5	Light blue-green	Cloudy, 9°C (48°F), S wind 8 mph, 1' waves.

Table 9. Transparency Measurements and Weather and Water Surface Observations in 2006, Quabbin Reservoir Site Den Hill.

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 20, 2006	4.0	Dark green	Clear, 23°C (73°F), N wind 5-7 mph, 6" waves.
May 17, 2006	7.1	Light yellow-brown	Partly cloudy, 22°C (72°F), S wind 3 mph, slight ripple.
June 21, 2006	7.1	Light yellow-brown	Partly cloudy, 23°C (73°F), S wind 1 mph, calm water surface.
July 26, 2006	6.7	Light yellow-brown	Fair, 30°C (86°F), SWwind 2 mph, slight ripple.
August 16, 2006	6.0	Light yellow-brown	Fair, 28°C (89°F), NW wind 2-3 mph, slight ripple.
September 21, 2006	8.7	Light blue-green	Fair, 16°C (61°F), N wind 3 mph, 6" waves.
October 19, 2006	7.8	Light blue-green	Partly cloudy, 13°C (55°F), S wind 1-2 mph, 3" waves.
November 15, 2006	8.4	Dark slate green	Overcast, 13°C (55°F), SW wind 2-3 mph, light waves.
December 14, 2006	7.0	Light yellow-brown	Partly sunny, 11°C (52°F), SW wind 2 mph, slight ripple.

Coliform and E. coli Bacteria

The term "coliform" is used to describe a group of bacteria based on biochemical functions and not on taxonomy. Both "total" coliform and "fecal" coliform bacteria have been used as indicators of fecal contamination, although total coliforms may include many species that are natural inhabitants of the aquatic system and the environment (Wolfram, 1996; Dutka and Kwan, 1980). The so-called "fecal" coliform group is a subset of the total coliform group that can grow at temperatures comparable to those in the intestinal tracts of warm-blooded animals (Toranzos and McFeters, 1997). Because of this ability to grow at elevated temperatures, the fecal coliform group may be considered a better indicator of recent fecal pollution. However, the term "fecal" coliform is somewhat of a misnomer, as some bacteria within this grouping may originate from environmental sources rather than fecal contamination (Toranzos and McFeters, 1997; Leclerc *et al.*, 2001). *E. coli* bacteria, which are normal inhabitants of the intestinal tracts of humans and other warm-blooded animals, are a better indicator of recent fecal pollution in temperate climates.

During 2006, in-reservoir coliform bacteria levels were monitored monthly at the routine reservoir stations beginning on April 20 and ending on December 14. During periods of thermal stratification, grab samples were collected from the surface, from the six-meter depth, and from the respective water supply intake depth at the two deep basin sites (Shaft 12 and Winsor Dam). Fecal coliform bacteria levels in reservoir samples were very low in 2006, with most results showing three colonies or less per 100 mL. The maximum concentration of 19 cfu/100 mL was measured in the deep sample collected from Site 206 on August 16, 2006, and might have been slightly elevated following recent storms (0.64 inches of rain in the previous two days). A seasonal gull population that roosts on the reservoir overnight has been identified as the primary contributor of fecal coliform bacteria contamination to the reservoir. Other sources may include other waterfowl, semi-aquatic wildlife and tributary inputs. However, because of the long residence time of the reservoir (reported on the magnitude of several years), fecal coliform bacteria levels are normally very low reflecting die-off and predation that occurs naturally.

Reservoir total coliform bacteria concentrations are much more dynamic, ranging from not detected (less than 10) to 3,280 colonies per 100 mL in 2006. Currently, a lack of a clear understanding of the natural microbial flora of the reservoir and a poor correlation of total coliform levels with reservoir fecal coliform levels (Lee, 2004) makes fecal coliform the indicator of choice for tracking contamination purposes. This approach is consistent with the EPA Surface Water Treatment Rule finding which specified that when both total and fecal coliform bacteria are analyzed, the fecal findings have precedent.

E. coli bacteria were not detected in the reservoir samples except in two samples at Site 202 (Winsor Dam), where concentrations were reported at the detection limit of 10 MPN/100 mL.

The first instance occurred on October 19, at the surface sample station, and the second instance occurred on November 15, in the deepest sample station. These results appear to coincide with the reservoir's fall turnover, when mixing and sedimentation can occur between shallow and deeper waters. Results at the Winsor Disinfection Facility showed that fecal coliform results remained low (3 colonies or less per 100 mL) during these instances.

Reservoir Phytoplankton and Nutrient Dynamics

The nutrient database for Quabbin Reservoir established in the 1998-99 year of monthly sampling and subsequent quarterly sampling through 2005 is used as a basis for interpreting data generated in 2006 (see **Table 10**). Results of quarterly nutrient sampling in 2006 documented concentrations of phosphorus, ammonia, and nitrate that registered at the low end of historical ranges. The total phosphorus concentrations, in particular, have remained very low during 2005 and 2006. In contrast, silica concentrations generally registered on the higher end and, in the case of the two deep water basins, the 2006 ranges exceeded historical maximums. A plausible explanation for these elevated silica levels is that diatom populations were limited by an exceptional scarcity of phosphorus such that the typical processes of diatom growth and sedimentation did not function to remove as much silica from the water (Worden, 2006).

In general, the patterns of nutrient distribution in 2006 quarterly samples were comparable to those documented previously in the 2000 report on Quabbin nutrient and plankton dynamics. These patterns consist of the following: (1) prominent seasonal and vertical variations due to demand by phytoplankton in the trophogenic zone (low concentrations in the epilimnion and metalimnion) and decomposition of sedimenting organic matter in the tropholytic zone (higher concentrations accumulating in the hypolimnion), (2) a lateral gradient in silica concentrations correlated to hydraulic residence time and mediated by diatom population dynamics, (3) and variably higher concentrations and intensities at the Den Hill monitoring station due to the loading effects of the East Branch Swift River.

Table 10. Quabbin Reservoir Nutrient Concentrations:

Comparison of Ranges from 1998-2005 Database[1] to Results from 2006 Quarterly Sampling[2] (Worden, 2006)

Sampling Station [3]	Ammonia (NH3; ug/L)		Nitrate (NO3; ug/L)		Silica (SIO2; mg/L)		Total Phosphorus (ug/L)		UV254 (Absorbance/cm)	
	1998-05	Quarterly'06	1998-05	Quarterly'06	1998-05	Quarterly'06	1998-05	Quarterly'06	1998-05	Quarterly'06
WD/202 (E)	<5 - 16	<5 - 9	<5 - 23	<5 - 14	0.84 - 1.98	2.04 - 2.34	<5 - 20	<5 - 9	0.017 - 0.026	0.025 - 0.029
WD/202 (M)	<5 - 29	6 - 9	<5 - 27	<5 - 18	0.83 - 2.07	2.19 - 2.37	<5 - 13	<5 - 8	0.017 - 0.028	0.026 - 0.030
WD/202 (H)	<5 - 53	8 - 25	<5 - 54	13 - 41	1.08 - 2.58	2.16 - 2.86	<5 - 44	<5 - 13	0.017 - 0.026	0.025 - 0.026
MP/206 (E)	<5 - 10	<5 - 7	<5 - 20	<5 - 12	0.84 - 1.88	1.88 - 2.24	<5 - 12	<5 - 7	0.017 - 0.031	0.024 - 0.030
MP/206 (M)	<5 - 34	<5 - 7	<5 - 44	<5 - 12	0.84 - 2.15	1.92 - 2.25	<5 - 12	<5 - 8	0.017 - 0.029	0.026 - 0.031
MP/206 (H)	<5 - 105	5 - 37	<5 - 95	9 - 77	1.02 - 2.32	1.93 - 2.93	<5 - 19	<5 - 7	0.018 - 0.029	0.026 - 0.029
Den Hill (E)	<5 - 19	5 - 12	<5 - 45	<5 - 15	0.74 - 4.64	1.72 - 2.96	<5 - 15	<5 - 9	0.025 - 0.122	0.037 - 0.064
Den Hill (M)	<5 - 25	6 - 12	<5 - 58	<5 - 20	0.84 - 4.37	1.65 - 2.57	<5 - 15	<5 - 8	0.027 - 0.139	0.040 - 0.063
Den Hill (H)	<5 - 84	12 - 42	<5 - 78	15 - 58	0.83 - 4.25	2.10 - 3.48	<5 - 15	<5 - 11	0.028 - 0.171	0.042 - 0.069

Notes: (1) 1998-05 database composed of 1998-99 year of monthly sampling and subsequent quarterly sampling conducted through December 2005, except for measurement of UV254 initiated in 2000 quarterly sampling

(2) 2006 quarterly sampling conducted May, July, October, and December

(3) Water column locations are as follow: E = epilimnion/surface, M = metalimnion/middle, H = hypolimnion/bottom

Macrophyte Surveys

Surveys of macrophytes (aquatic plants) have been conducted annually in Quabbin Reservoir, starting in 1998. The macrophyte surveys focused primarily on areas most susceptible to introduction of alien species. These areas included the three boat launching areas in the main basin, Pottapaug Pond (impounded portion of East Branch Swift River northeast of Boat Area 3), the Northern Settling Pond (impounded portion of Middle Branch Swift River north of Boat Area 2), and selected portions of Quabbin Reservoir shoreline that include tributary inlets and quiescent coves. See **Appendix A** for further detail on areas surveyed. In 2006, the Northern Settling Pond was surveyed on July 6. Twelve different species were identified during this recent survey, including patches of one non-native species, Variable Water-milfoil (*Myriophyllum heterophyllum*). Variable Water-milfoil was found to be a dominant species in Pottapaug Pond during the 1999 and 2005 surveys.

Because Quabbin Reservoir is managed as a drinking water supply reservoir, water level in the main basin can be lowered by as much as 10 to 12 feet for an extended period of time. Such water level fluctuations can kill aquatic plants by dessicating the substrates supporting plant growth. Consequently, the macrophyte diversity and distribution is generally greater where water level does not fluctuate significantly or where substrates can retain moisture (such as those with fine organic sediment) from groundwater.

Overall, the surveys conducted by DCR staff indicated that a sparse community of macrophytes exists within the main basin, whereas impounded areas such as Pottapaug Pond and the Middle Branch Swift Impoundment have extensive beds of macrophytes. All macrophytes were identified as native species except for Variable Water-milfoil, which is indigenous to North America but not to the New England region. Future DCR surveys will focus on the Middle Branch and East Branch Swift subwatersheds, since these subwatersheds present ideal growth conditions for alien species colonization.

In addition to the annual surveys conducted by DCR staff, a more intensive and wide-ranging survey of the Quabbin Reservoir and Ware River watersheds was conducted in July and August 2006 by Geosyntec Consultants, Inc., in order to evaluate any further needs for aquatic plant management within both of these watersheds. Fifty-nine species of aquatic plants were identified in the areas selected for Geosyntec's survey, with Variable Water-milfoil identified as the only non-native species. Geosyntec catalogued aquatic plant species observed at 327 sampling stations within the Quabbin Reservoir survey areas and 22 sampling stations within one mile upstream of the Shaft 8 Intake at Ware River.

Aquatic plants were generally sparse in Quabbin Reservoir and generally found in shallow areas (less than 20 feet deep), except in areas with "stony, inorganic substrates" or subject to "high-

energy wind and wave action" (Geosyntec, 2006a). As DCR staff had noted, Variable Water-milfoil was a dominant species in Pottapaug Pond, and White Waterlily (*Nymphaea odorata*) was a dominant species in the Northern Settling Pond. In the main basin of Quabbin Reservoir, Golden Hedge Hyssop (*Gratiola aurea*), Bur-reed (*Sparganium sp.*), and Robbins' Spike Rush (*Eleocharis robinsii*) were most commonly found. In the Ware River, the aquatic plant growth was also sparse, with the Yellow Waterlily (*Nuphar spp.*) being the dominant plant in the area surveyed. Variable Water-milfoil was the only non-native species observed in the surveyed areas.

Based on their survey, Geosyntec recommended that monitoring continue on the extent and distribution of Variable Water-milfoil, as well as presence of new, non-native macrophyte species. Geosyntec recommended that future monitoring continue on the three boat launching areas (also known as Boat Areas 1, 2, and 3, or Fishing Areas 1, 2, and 3), the Northern Settling Pond, Pottapaug Pond, and also adding the Ware River Shaft 8 Intake area. No additional aquatic plant management was recommended at this time. In addition to the aquatic macrophyte assessment report (Geosyntec, 2006a), Geosyntec also produced a *Field Guide to the Aquatic Plants of Quabbin Reservoir* (Geosyntec, 2006b) to assist MWRA or DCR staff in routine monitoring efforts.

3.2 RESULTS - TRIBUTARY MONITORING

Monitoring of tributary water quality is not required by the SWTR or other regulations. However, routine monitoring of the tributaries does serve to establish a baseline of water quality data, from which trends may be used to identify subwatersheds where localized activities may be adversely impacting water quality.

Fecal Coliform Bacteria

In 2006, fecal coliform bacteria concentrations generally fell within the historical range for each respective station, and the median concentrations fell below the Class A Standard of 20 CFU/100mL. Of the sites where routine monitoring began in 2005, West Branch Swift River Site 211E (Sibley) and Site 211G (Cooleyville), Middle Branch Swift River at Fay Road (Site 213A), Comet Pond Outlet (Site 116), and Thayer Pond Outlet (Site 121A) had slightly higher concentrations of fecal coliform bacteria in 2006, compared to 2005. Except for Thayer Pond Outlet, fecal coliform concentrations did not exceed historical maximum levels at the twelve "core" sampling stations.

Total Coliform Bacteria

During 2006, all analyses for total coliform bacteria concentrations were determined using an enzyme substrate procedure (Colilert method) instead of membrane filtration, the technique that had been used historically. No clear correlation between the two methods was found in side-by-

side testing, and it appears that the results obtained in 2006 are not directly comparable to the historical data because of the difference in laboratory methods. The range of values appears to have shifted higher, although maximum values did not increase at all sites. At the twelve core sites, the 75th percentile, median, 25th percentile, and minimum values for total coliform concentrations were higher in 2006 than in the historical record, which for many sites dates back to 1990, while maximum values in 2006 exceeded the historical range at five of twelve core sites. In addition, the median concentrations of total coliform bacteria exceeded the historical 75th percentile at six of seven core sampling stations in the Quabbin Reservoir watershed and at all five core sampling stations in the Ware River watershed. While it is possible that environmental factors could have resulted in these higher concentrations, it might be difficult to discern any trends until several years of data have been collected using the same laboratory method.

E. coli Bacteria

Although it has not correlated very well with membrane filtration (the method used historically), the Colilert method has the advantage of detecting *E. coli* without requiring additional confirmation procedures. In 2006, the *E. coli* results ranged from less than 10 MPN/100 mL to 6,130 MPN/100 mL. The maximum concentration was recorded in Boat Cove Brook on August 15, a date when elevated *E. coli* concentrations were also detected in Hop Brook (Site 212B), Middle Branch Swift River (Site 213A), and Gates Brook. These elevated results occurred following a rainfall of 0.64 inch on August 14 and 15. An investigation in the Boat Cove Brook area did not uncover significant wildlife impacts and concluded that storm runoff or bank sediment washing into the brook may have led to the elevated *E. coli* result; see **Appendix A** for the investigation summary.

Specific Conductance

Specific conductance is the measure of the ability of water to conduct an electrical current, which is dependent on the concentration and availability of mineral ions. Elevated levels in streams may be indicative of contamination from septic system effluent, stormwater discharges or agricultural runoff. One significant source of higher levels in tributaries is chloride found in deicing salts applied to highways and local roads (Shanley, 1994; Lent et. al, 1998). It is suspected that deicing salts contributed to elevated values of specific conductance over recent years, with peak values recorded in 2001 through 2004. In 2006, specific conductance values were generally within the historical range, which could be partly related to the relatively mild winter in early 2006 and/or the significant rainfall on October 2005 and May and June 2006.

Dissolved Oxygen

The oxygen concentration of tributaries of Quabbin Reservoir and Ware River watershed were generally quite high. Concentrations ranged between 0.20 mg/L and 23.6 mg/L. The source of dissolved oxygen in a stream environment comes from re-aeration dynamics. Dissolved oxygen levels are depleted though the oxygen requirements of aquatic life, the decomposition of organic

matter, and the introduction of foreign oxygen-demanding substances (*i.e.*, chemical reducing agents). Temperature, stream flow, water depth and the physical characteristics of the stream channel are the principal drivers of re-aeration. The Massachusetts Class A standard is a minimum of 6.0 mg/L. Dissolved oxygen levels were measured below the 6.0 mg/L threshold in 13 percent of the samples monitored within the Ware River watershed and 5.3 percent of the samples monitored within the Quabbin Reservoir watershed.

Temperature

In tributaries of Quabbin Reservoir and Ware River watersheds, temperatures ranged between 0 and 25.3˚C. Temperature is an important parameter in its relation to dissolved oxygen because as temperature increases the amount of oxygen that can be dissolved in water decreases. Moreover, higher temperatures increase the solubility of nutrients and may correlate well with an increase in the growth of filamentous green algae

Turbidity

Turbidity is the relative measure of the amount of light-refracting and light-absorbing particles suspended in the water column. It is used as an indicator of water aesthetics and as a relative measure of the water's productivity. The Massachusetts drinking water standard is 5 NTU for source water and 1 NTU for finished water. In 2006, turbidity levels exceeded the 5 NTU standard at three of twenty-four tributary monitoring stations: Ware River at Shaft 8 (Site 101), Hop Brook at Gate 22 Road (Site 212), and Hop Brook at Gate 22 (Site 212A). The highest turbidity level recorded was 9.75 NTU, measured in Hop Brook (Site 212A) on August 15. It appears that turbidity increased steadily in July and August as stream flow decreased; a steady decrease in turbidity appeared to coincide with a series of late August storm events.

pH

Stream acidity is largely a function of the groundwater hydrogeology of the basins and their effectiveness in buffering the effects of acid precipitation. pH is a measure of the number of hydrogen ions [H+] reported on a log scale of 0 to 14. An [H+] concentration of 7.0 represents neutral water and levels below this are considered acidic with a decrease of one unit representing a 10-fold increase in acidity. Median pH values in 2006 were below the Class A water quality threshold of 6.5 units at 17 of 24 monitoring stations. Sites with median levels below 6.0 include Gates Brook, East Branch Fever Brook (Site 215), the Sibley reach (Site 211E) and the New Boston reach (Site 211F) of the West Branch Swift River, Cushing Pond Outlet (Site 108B), and Comet Pond Outlet Tributary (Site 116B).

Alkalinity

Alkalinity, a relative measure of water's ability to neutralize an acid, was monitored at the twelve Environmental Quality Assessment sites on a biweekly basis in 2006 to gather baseline data for these sites. Data from these sites were compared to acid rain assessment criteria established under the Acid Rain Monitoring (ARM) Project at the University of Massachusetts.

The ARM criteria are based on average results for the month of April (Godfrey *et al.*, 1996). In 2006, the alkalinity (standard method) concentrations were below the ARM endangered threshold value of 5 mg/L as $CaCO_3$ at six of twelve tributary monitoring sites: the Sibley reach (Site 211E) and the New Boston reach (Site 211F) of the West Branch Swift River, Cushing Pond Outlet (Site 108B), the Bickford reach of the East Branch Ware River (Site 108C), Comet Pond Outlet (Site 116), and Comet Pond Outlet Tributary (Site 116B).

Tributary Nutrient Dynamics

Beginning in March 2005, sampling was begun on selected tributaries with the goal of establishing a nutrient database for each subwatershed. Aggressive monitoring (biweekly) was begun on four subwatersheds where Environmental Quality staff is actively engaged in sanitary surveys. These subwatersheds include: Middle Branch Swift River, Hop Brook, West Branch Swift River, and the East Branch Ware River. In addition, core tributary stations were monitored on a quarterly basis. **Table 11** summarizes median values and range of 2006 data for all tributary monitoring sites in the Quabbin Reservoir watershed, and **Table 12** summarizes the data similarly for Ware River watershed sites.

Table 11. Quabbin Reservoir Watershed Nutrient Concentrations: Comparison of Median Values and Ranges from 2006 Database

Sampling Station	Nitrate (NO_3; µg/L)		Total Kjeldahl Nitrogen (TKN; µg/L)		Total Phosphorus (µg/L)		UV_{254} (Absorbance/cm)	
	Median '06	Range, Biweekly'06	Median '06	Range, Biweekly'06	Median '06	Range, Biweekly'06	Median '06	Range, Biweekly'06
West Branch Swift [1]								
211E	19	<5 – 100	154	74 – 236	8	<5 – 15	0.097	0.049 – 0.162
211F	24	<5 – 118	144	86 – 309	9	<5 – 22	0.130	0.064 – 0.237
211G	50	19 – 134	100	68 – 167	14	<5 – 22	0.052	0.024 – 0.093
Hop Brook [1]								
212A	23	<5 – 142	161	103-333	13	<5 – 42	0.121	0.046 – 0.305
212B	98	<5 – 198	149	66 – 248	11	<5 – 24	0.090	0.039 – 0.190
Middle Branch Swift [1]								
213A	60	11 – 304	223	119 – 414	18	6 – 43	0.154	0.064 – 0.261
213B	78	19 – 203	167	100 – 328	12	<5 – 21	0.134	0.066 – 0.231
Core Sample Sites [2]	**Median '06**	**Range, Quarterly '06**	**Median '06**	**Range, Quarterly '06**	**Median '06**	**Range, Quarterly '06**		
211 (W. Swift)	58	10 – 106	174	120 – 227	15	10 – 21		
212 (Hop)	71	56 – 86	192	109 – 274	22	10 – 34		
213 (M. Swift)	23	17 – 29	265	194 – 336	18	13 – 23		
215 (E. Fever)	41	<5 – 81	385	302 – 468	23	17 – 29		
216 (E. Swift)	45	24 – 66	278	260 – 295	21	19 – 24		
Boat Cove Brook	11	9 – 13	364	261 – 466	41	16 – 66		
Gates Brook	18	<5 – 37	79	<5 - 157	15	10 – 20		

Notes: (1) Biweekly sampling at Environmental Quality Assessment sites.
(2) "Quarterly" sampling conducted only twice, in August and November, because of logistical problems (missing sample bottles).

Table 12. Ware River Watershed Nutrient Concentrations: Comparison of Median Values and Ranges from 2006 Database

Sampling Station	Nitrate (NO_3; µg/L)		Total Kjeldahl Nitrogen (TKN; µg/L)		Total Phosphorus (µg/L)		UV_{254} (Absorbance/cm)	
	Median '06	Range, Biweekly'06	Median '06	Range, Biweekly'06	Median '06	Range, Biweekly'06	Median '06	Range, Biweekly'06
108A W.R.(1)	13	<5 – 88	328	182 – 472	20	6 – 42	0.247	0.127 - 0.392
108B W.R.(1)	83	<5 – 168	398	<5 – 635	20	5 – 35	0.246	0.090 - 0.363
108C W.R.(1)	35	<5 – 123	197	<5 – 268	10	<5 – 16	0.099	0.070 - 0.177
116 W.R.(1)	<5	<5 – 45	185	<5 – 318	6	<5 – 13	0.054	0.044 - 0.062
116B W.R.(1)	<5	<5 – 25	385	<5 – 890	32	8 – 82	0.341	0.129 - 0.802
Core Sample Sites (2)	**Median '06**	**Range, Quarterly '06**	**Median '06**	**Range, Quarterly '06**	**Median '06**	**Range, Quarterly '06**	**Median '06**	**Range, Biweekly'06**
Shaft 8	48	<5 – 62	315	174 – 554	17	7 – 53	0.286	0.125 - 0.492
108 W.R.	31	6 – 48	330	276 – 461	21	10 – 40	0.272	0.128 - 0.413
121A W.R.	<5	<5 – 161	333	192 – 458	15	<5 – 19	0.224	0.081 - 0.340
103A W.R.	29	7 – 54	309	180 – 386	24	11 – 35	0.263	0.109 - 0.402
107A W.R.	38	8 – 90	357	218 - 474	23	11 – 48	0.431	0.183 - 0.640

Notes: (1) Biweekly sampling at environmental Quality Assessment sites.
(2) Quarterly sampling conducted in February, April, August, and October.

Nutrient concentrations measured in 2006 were compared with ecoregion reference conditions established as part of a national water quality assessment performed by the US EPA. Regional reference conditions (*i.e.*, background levels) were assigned as the 25th percentile value of a ten-year database begun in 1990 (US EPA, 2000). Total nitrogen concentrations across the Quabbin and Ware River watersheds generally remained below EPA reference conditions. Median concentrations of total phosphorus generally were higher than the Ecoregion VIII criterion of 10.00 µg/L (0.010 mg/L) and lower than the Ecoregion XIV criterion of 31.25 µg/L (0.03125 mg/L). Two sites, the Boat Cove site in the Quabbin Reservoir watershed and Comet Pond Outlet Tributary (Site 116B) in the Ware River watershed, had median concentrations of total phosphorus above 31.25 µg/L. Both of these sites are heavily influenced by wildlife; the Boat Cove area has a high density of deer, and the Comet Pond Outlet Tributary is in the middle of a beaver impoundment. Note that the ecoregional criteria are guideline values only and are not enforceable at this time; they are referenced here for comparison purposes only. It is not known whether concentrations higher than the ecoregional criteria constitute any significant cause for concern within the Quabbin Reservoir and Ware River watersheds.

UV_{254} absorbance values within Quabbin Reservoir watershed were compared with historical data collected between 1997 and 2000 through a special investigation by the University of Massachusetts (Garvey *et al.*, 2001). Note that the 1997-2000 data were collected at the mouth of each tributary, whereas the more recent UV_{254} absorbance data were collected along smaller branches upstream. The 2006 results for the Middle Branch Swift sites registered within the range of historical data. For the West Branch Swift River, 2006 results for the Sibley (Site

211E) and Cooleyville (Site 211G) branches fell within the historical range at the tributary mouth, but UV_{254} absorbance values in the New Boston branch exceeded the historical range. One possible explanation is the closer proximity to upstream beaver impoundments, where dissolved organics are likely to be higher.

Monitoring for UV_{254} absorbance in Ware River tributaries began in 2005. The UV_{254} absorbance values in 2006 were comparable to the range of values observed in 2005, with 2006 median values generally similar to those in 2005. As might be expected in a watershed with more wetland areas, the UV_{254} absorbance values were higher in the Ware River tributaries compared to the Quabbin Reservoir tributaries.

4.0 PROPOSED SCHEDULE FOR 2007

Water sampling protocols, including sampling parameters and field and analytical methods, will remain the same for 2007. It is anticipated that the Environmental Quality Assessment sites will be changed to focus on other subwatersheds in the Quabbin Reservoir and Ware River watersheds. Seven of fourteen sites in the Quabbin tributary monitoring program will be changed, and five of ten sites in the Ware River watershed will be changed. The remaining tributary monitoring sites are core sites, which will continue to be monitored as they were in 2006.

No changes are proposed to the in-reservoir sampling program. Sampling at the three deep-water reservoir stations will continue, with temperature, dissolved oxygen, pH and conductivity profiles collected monthly. The reservoir nutrient and phytoplankton sampling program that has been conducted quarterly since 2000 will be continued in 2006.

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APPENDIX A

Investigative Reports and Data

Results of 2006 Quarterly Nutrient Sampling at Quabbin Reservoir

The Macrophyte Flora of Quabbin Reservoir

Pathogen Monitoring Data

Nutrient Results from Tributary Monitoring, March 2005 – January 2007

Inspection and Re-sampling at Sample Site 213A

Comet Pond Beach – Hubbardston

Inspection and Re-sampling at Boat Cove Sample Site

MEMO

TO: Bob Bishop and Scott Campbell
FROM: Dave Worden
DATE: February 1, 2006
RE: Results of 2006 Quarterly Nutrient Sampling at Quabbin Reservoir

The nutrient database for Quabbin Reservoir established in the 1998-99 year of monthly sampling and subsequent quarterly sampling through 2005 is used as a basis for interpreting data generated in 2006 (see Table 2006 and complete quarterly database in accompanying Excel file). Results of quarterly nutrient sampling in 2006 document concentrations and intensities that register entirely within historical ranges for all parameters except UV254 absorbance and silica. UV254 ranges increased slightly at a few locations, but these were minor increments over previous maximum values and have no significant water quality implications. Changes in silica concentrations were significant and are discussed in conjunction with total phosphorus concentrations below.

Results for total phosphorus were notable in that the time period when concentrations were below the minimum laboratory detection limit of 5 ug/L at all locations, observed in October and December 2005, was extended through the May17, 2006 sampling date. Assuming that concentrations did not spike between these sampling dates, the data indicate that extremely low phosphorus concentrations persisted throughout the system for seven months. This episode is unique in the historical database.

The consistently low phosphorus concentrations reflect the constant and intense demand for this nutrient by phytoplankton and reaffirm previous findings identifying phosphorus as the nutrient limiting phytoplankton growth in Quabbin Reservoir. Limitation of phytoplankton productivity by a deficiency of phosphorus relative to other nutrients is typical of most temperate lakes and reservoirs.

In the case of silica, concentrations measured in 2006 at Windsor Dam (Station 202) and at Mt. Pomeroy/Shaft 12 (Station 206) generally registered higher than the record maximums established last year and, consequently, represent a continuation of a trend toward higher concentrations that began in 2005. Silica concentrations have been shown to exhibit a lateral gradient across the flowpath through Quabbin Reservoir correlated to hydraulic residence time and mediated by diatom population dynamics (Worden, 2000).

A plausible explanation for the increasing silica concentrations measured in 2005 and 2006 is that diatom populations were limited by an exceptional scarcity of phosphorus (noted above) and that the typical processes of diatom growth and sedimentation did not function to remove as much silica from the water column as usual. Specifically, the higher silica concentrations measured at Windsor Dam (Station 202) and at Mt. Pomeroy/Shaft 12 (Station 206) may be

indirect evidence of weakened diatom population dynamics discernible as an enhanced pool of residual silica remaining in the water column at these locations. A similar inverse correlation between phosphorus and silica concentrations was observed in Wachusett Reservoir where non-detection of phosphorus (<5 ug/L) was documented over a several month period (December 2005 – May 2006) accompanied by record maximum silica concentrations and muted activity by diatoms.

The patterns of nutrient distribution in 2006 quarterly samples were comparable to those documented previously in the 2000 report on Quabbin nutrient and plankton dynamics. These patterns consist of the following: (1) prominent seasonal and vertical variations due to demand by phytoplankton in the trophogenic zone (resulting in low concentrations in the epilimnion and metalimnion) and decomposition of sedimenting organic matter in the tropholytic zone (resulting in higher concentrations accumulating in the hypolimnion), (2) a lateral gradient in silica concentrations correlated to hydraulic residence time and mediated by diatom population dynamics, and (3) variably higher concentrations and intensities at the Den Hill monitoring station due to the loading effects of the East Branch Swift River. Future nutrient sampling at Quabbin Reservoir is planned to continue on the established quarterly schedule. Please contact me with any questions or comments.

Reference Cited

Worden, David. 2000. Nutrient and Plankton Dynamics in Quabbin Reservoir: Results of the MDC/DWM's 1998-99 Sampling Program. Metropolitan District Commission, Division of Watershed Management.

2006 Quabbin Reservoir Nutrient Concentrations

Results of Quarterly Nutrient Sampling:
Nitrate (mg/L; MDL = 0.005 mg/L)

I.D.	Sampling Station	Sampling Date				Median	Average	Min.	Max.
		05/1706	07/31/06	10/19/06	12/14/06				
MD28	WD/202 (E)	0.014	*0.005*	*0.005*	0.014	0.009	0.009	*0.005*	0.014
MD29	WD/202 (M)	0.018	*0.005*	0.008	0.013	0.011	0.011	*0.005*	0.018
MD30	WD/202 (H)	0.027	0.041	0.036	0.013	0.032	0.029	0.013	0.041
MD37	MP/206 (E)	0.012	*0.005*	*0.005*	0.009	0.007	0.008	*0.005*	0.012
MD38	MP/206 (M)	0.012	*0.005*	0.007	0.009	0.008	0.008	*0.005*	0.012
MD39	MP/206 (H)	0.016	0.038	0.077	0.009	0.027	0.035	0.009	0.077
MD40	Den Hill (E)	0.013	*0.005*	0.005	0.015	0.009	0.009	*0.005*	0.015
MD41	Den Hill (M)	0.020	*0.005*	0.006	0.014	0.010	0.011	*0.005*	0.020
MD42	Den Hill (H)	0.031	0.032	0.058	0.015	0.032	0.034	0.015	0.058

Note: values show in italix are <MDL

Results of Quarterly Nutrient Sampling:
TKN (mg/L; MDL = 0.05)

I.D.	Sampling Station	Sampling Date				Median	Average	Min.	Max.
		05/1706	07/31/06	10/19/06	12/14/06				
MD28	WD/202 (E)	0.171	0.158	0.153	0.116	0.156	0.150	0.116	0.171
MD29	WD/202 (M)	0.134	0.155	0.133	0.129	0.134	0.138	0.129	0.155
MD30	WD/202 (H)	0.144	0.145	0.147	0.127	0.145	0.141	0.127	0.147
MD37	MP/206 (E)	0.169	0.140	0.134	0.128	0.137	0.143	0.128	0.169
MD38	MP/206 (M)	0.177	0.146	0.144	0.131	0.145	0.150	0.131	0.177
MD39	MP/206 (H)	0.171	0.156	0.127	0.132	0.144	0.147	0.127	0.171
MD40	Den Hill (E)	0.186	0.148	0.187	0.163	0.175	0.171	0.148	0.187
MD41	Den Hill (M)	0.148	0.152	0.162	0.194	0.157	0.164	0.148	0.194
MD42	Den Hill (H)	0.164	0.149	0.152	0.191	0.158	0.164	0.149	0.191

2006 Quabbin Reservoir Nutrient Concentrations

Results of Quarterly Nutrient Sampling:
Ammonia (mg/L; MDL = 0.005 mg/L)

I.D.	Sampling Station	Sampling Date				Median	Average	Min.	Max.
		05/1706	07/31/06	10/19/06	12/14/06				
MD28	WD/202 (E)	0.008	0.007	*0.005*	0.009	0.008	0.007	*0.005*	0.009
MD29	WD/202 (M)	0.006	0.006	0.008	0.009	0.007	0.007	0.006	0.009
MD30	WD/202 (H)	0.009	0.021	0.025	0.008	0.015	0.016	0.008	0.025
MD37	MP/206 (E)	*0.005*	0.007	*0.005*	0.006	0.006	0.006	*0.005*	0.007
MD38	MP/206 (M)	*0.005*	0.007	0.006	0.006	0.006	0.006	*0.005*	0.007
MD39	MP/206 (H)	0.005	0.037	0.022	0.007	0.014	0.018	0.005	0.037
MD40	Den Hill (E)	0.005	0.008	0.006	0.012	0.007	0.008	0.005	0.012
MD41	Den Hill (M)	0.007	0.008	0.006	0.012	0.008	0.008	0.006	0.012
MD42	Den Hill (H)	0.014	0.029	0.042	0.012	0.022	0.024	0.012	0.042

Note: values show in italix are <MDL

Results of Quarterly Nutrient Sampling:
Total Phosphorus (mg/L; MDL = 0.005 mg/L)

I.D.	Sampling Station	Sampling Date				Median	Average	Min.	Max.
		05/1706	07/31/06	10/19/06	12/14/06				
MD28	WD/202 (E)	*0.005*	0.006	0.009	0.006	0.006	0.006	*0.005*	0.009
MD29	WD/202 (M)	*0.005*	0.007	0.008	0.006	0.006	0.006	*0.005*	0.008
MD30	WD/202 (H)	*0.005*	0.013	0.008	0.006	0.007	0.008	*0.005*	0.013
MD37	MP/206 (E)	*0.005*	0.007	0.006	0.006	0.006	0.006	*0.005*	0.007
MD38	MP/206 (M)	*0.005*	0.007	0.005	0.008	0.006	0.006	*0.005*	0.008
MD39	MP/206 (H)	*0.005*	0.007	0.006	0.006	0.006	0.006	*0.005*	0.007
MD40	Den Hill (E)	*0.005*	0.006	0.006	0.009	0.006	0.007	*0.005*	0.009
MD41	Den Hill (M)	*0.005*	0.006	0.007	0.008	0.006	0.006	*0.005*	0.008
MD42	Den Hill (H)	*0.005*	0.009	0.011	0.008	0.008	0.008	*0.005*	0.011

Note: values show in italix are <MDL

2006 Quabbin Reservoir Nutrient Concentrations

Results of Quarterly Nutrient Sampling:
UV254 (A/cm)

I.D.	Sampling Station	Sampling Date				Median	Average	Min.	Max.
		05/1706	07/31/06	10/19/06	12/14/06				
MD28	WD/202 (E)	0.029	0.027	0.025	0.025	0.026	0.027	0.025	0.029
MD29	WD/202 (M)	0.027	0.030	0.026	0.027	0.027	0.028	0.026	0.030
MD30	WD/202 (H)	0.026	0.025	0.025	0.026	0.026	0.026	0.025	0.026
MD37	MP/206 (E)	0.030	0.027	0.024	0.027	0.027	0.027	0.024	0.030
MD38	MP/206 (M)	0.031	0.028	0.028	0.026	0.028	0.028	0.026	0.031
MD39	MP/206 (H)	0.029	0.027	na	0.026	0.027	0.027	0.026	0.029
MD40	Den Hill (E)	0.058	0.043	0.037	0.064	0.051	0.050	0.037	0.064
MD41	Den Hill (M)	0.040	0.049	na	0.063	0.049	0.050	0.040	0.063
MD42	Den Hill (H)	0.054	0.042	0.045	0.069	0.049	0.052	0.042	0.069

Results of Quarterly Nutrient Sampling:
Alkalinity (mg/L as $CaCO_2$)

I.D.	Sampling Station	Sampling Date				Median	Average	Min.	Max.
		05/1706	07/31/06	10/19/06	12/14/06				
MD28	WD/202 (E)	2.58	2.50	3.30	4.74	2.94	3.28	2.50	4.74
MD29	WD/202 (M)	2.52	2.58	2.64	2.54	2.56	2.57	2.52	2.64
MD30	WD/202 (H)	2.56	2.64	3.00	2.64	2.64	2.71	2.56	3.00
MD37	MP/206 (E)	2.66	2.68	2.62	2.64	2.65	2.65	2.62	2.68
MD38	MP/206 (M)	2.66	2.60	2.76	2.82	2.71	2.71	2.60	2.82
MD39	MP/206 (H)	2.60	2.64	2.14	2.80	2.62	2.55	2.14	2.80
MD40	Den Hill (E)	2.68	2.74	3.14	3.16	2.94	2.93	2.68	3.16
MD41	Den Hill (M)	2.60	2.56	3.32	3.12	2.86	2.90	2.56	3.32
MD42	Den Hill (H)	2.58	2.86	3.04	3.00	2.93	2.87	2.58	3.04

2006 Quabbin Reservoir Nutrient Concentrations

Results of Quarterly Nutrient Sampling:
Silica (mg/L)

I.D.	Sampling Station	Sampling Date				Median	Average	Min.	Max.
		05/1706	07/31/06	10/19/06	12/14/06				
MD28	WD/202 (E)	2.34	2.24	2.04	2.24	2.24	2.22	2.04	2.34
MD29	WD/202 (M)	2.37	2.23	2.19	2.27	2.25	2.27	2.19	2.37
MD30	WD/202 (H)	2.51	2.66	2.86	2.16	2.59	2.55	2.16	2.86
MD37	MP/206 (E)	2.24	1.99	1.88	1.96	1.98	2.02	1.88	2.24
MD38	MP/206 (M)	2.25	2.10	2.00	1.92	2.05	2.07	1.92	2.25
MD39	MP/206 (H)	2.24	2.47	2.93	1.93	2.36	2.39	1.93	2.93
MD40	Den Hill (E)	2.96	1.77	1.72	2.10	1.94	2.14	1.72	2.96
MD41	Den Hill (M)	2.57	1.65	1.73	2.21	1.97	2.04	1.65	2.57
MD42	Den Hill (H)	2.95	3.02	3.48	2.10	2.99	2.89	2.10	3.48

Results of Quarterly Nutrient Sampling:
Dissolved Silica (mg/L)

I.D.	Sampling Station	Sampling Date				Median	Average	Min.	Max.
		05/1706	07/31/06	10/19/06	12/14/06				
MD28	WD/202 (E)	0.84	2.07	2.00	2.22	2.04	1.78	0.84	2.22
MD29	WD/202 (M)	0.82	1.93	2.14	2.19	2.04	1.77	0.82	2.19
MD30	WD/202 (H)	0.81	2.46	2.63	2.10	2.28	2.00	0.81	2.63
MD37	MP/206 (E)	0.77	1.99	1.87	1.90	1.89	1.63	0.77	1.99
MD38	MP/206 (M)	0.65	1.92	1.89	1.89	1.89	1.59	0.65	1.92
MD39	MP/206 (H)	2.18	2.47	2.87	1.90	2.33	2.36	1.90	2.87
MD40	Den Hill (E)	2.85	1.62	1.70	2.02	1.86	2.05	1.62	2.85
MD41	Den Hill (M)	2.54	1.54	1.70	2.02	1.86	1.95	1.54	2.54
MD42	Den Hill (H)	2.95	2.51	3.02	2.08	2.73	2.64	2.08	3.02

THE MACROPHYTE FLORA OF QUABBIN RESERVOIR

Survey Timetable and Field Methods

Characterization of the macrophyte flora of Quabbin Reservoir by DWSP staff was initiated in 1998 through systematic surveys of the reservoir system starting with the three boat launching areas in the main basin, Pottapaug Pond (impounded portion of East Branch Swift River adjacent to Boat Area #3), and the impounded portion of Middle Branch Swift River (adjacent to Boat Area #2) where the greatest potential for introduction of alien species exists (Table 1). These surveys entailed visual inspection

Table 1 - Timetable of Quabbin Macrophyte Surveys

Date	Areas Surveyed
Aug. 25, 1998	Boat Area #1
Oct. 7, 1999	Pottapaug Pond (second survey conducted in 2005; see below)
Sept. 22, 2000	Impounded Portion of Middle Branch Swift River, Shaft 11A Cove, and extreme Northern Cove (adjacent to Boat Area #2 "causeway")
Aug. 17, 2001	Boat Area #2 and New Salem Shoreline from Moosehorn Brook Inlet to Hop Brook Inlet
Aug. 21 and 27, 2002	Boat Area #3, Channel to Shaft 11A, Cove opposite Shaft 11A Channel, and around Den Hill (Aug. 21st); Boat Area #2, Upper Reaches above Boat Dock, and Bassett Island (Aug. 27th)
Sept. 9, 2003	Boat Area #1 and Western (Pelham) Shoreline of West Arm up to inlet of W. Branch Swift River
Aug. 27, 2004	Boat Area #3 and shoreline in vicinity of West Branch Fever Brook Inlet
Aug. 16, 2005	Pottapaug Pond (previously surveyed in 1999)
July 6, 2006	Impounded Portion of Middle Branch Swift River (previously surveyed in 2000)

of littoral zone habitats conducted from a canoe or boat with observations noted on a base map of each area. Observations of macrophyte beds in deeper water were enhanced through the use of a view scope. Surveys also included collection of macrophyte samples using a throw rake or an Ekman Grab to supplement visual observations and aid in plant

identification. All identifications are based on taxonomy given in Crow and Hellquist (2000).

In addition to the localized surveys conducted annually by DWSP staff, the Massachusetts Water Resources Authority (MWRA) contracted Geosyntec Consultants, Inc. to conduct an intensive and wide-ranging macrophyte survey of Quabbin Reservoir (and the Ware River) in 2006. The Geosyntec survey involved plant sampling, assessment of areal coverage and biomass, and GPS mapping at a total of 406 stations in key areas throughout the reservoir system (Geosyntec, 2006). The rigorous methodology and spatial coverage of this survey provide the most comprehensive database currently available on aquatic macrophytes in Quabbin Reservoir. DWSP survey results are summarized in the following sections, but the Geosyntec report must be consulted for detailed documentation of the Quabbin Reservoir macrophyte community.

Littoral Zone Characteristics, Water Elevation Dynamics, and Macrophyte Distribution in Quabbin Reservoir

Quabbin Reservoir has a shoreline totaling about 190 km (118 miles) in length. The outline of the reservoir is elongated and convoluted into three major sub-basins with many bays and coves due to the reservoir's origin as a flooded river valley. The complexity of a basin's shoreline can be quantified using the morphometric parameter known as "shoreline development." Shoreline development is the ratio of the length of the shoreline to the circumference of a circle equal in area to that of the basin. Many lake basins are subcircular or elliptical in shape with shoreline development values around 2.0, but Quabbin Reservoir has a value of 5.4 due to its intricate outline.

Characteristics of the littoral zone associated with this extensive shoreline vary greatly according to location. Major types of littoral zone substrates include wave-washed gravel, cobble, and boulders facing prevailing winds, bedrock outcrops, and sandy substrates derived from glacial outwash. Most importantly, deposits of fine organic sediment exist in tributary inlets and quiescent coves as a result of these locations receiving loads of suspended solids from tributary streams and/or being protected from high energy wind and wave action.

Macrophytes in the main basin of Quabbin are generally limited in distribution to these tributary inlets and quiescent coves. The patchy distribution characterizing the Quabbin flora is directly linked to the water supply function of the reservoir and associated fluctuations in water level elevations. The perennial transfer of water to Wachusett Reservoir and occasional years of drought conditions cause fluctuations in Quabbin water level as great as 10 to 12 feet with the result that extensive areas of littoral zone are dewatered and exposed to desiccation processes for extended periods, often several months. The most recent instance of this occurred in 2002 when water elevations declined steadily to a minimum of 516.5 feet (75.5% reservoir capacity) in November compared to an elevation of 528.5 feet (97% capacity) in May and June of the previous year.

Among specialists in lake management, the practice of intentionally lowering water levels to eliminate aquatic "weeds" by periodically dewatering their habitat is a commonly used and effective technique known as "drawdown." Roots and rhizomes of aquatic plants are killed when the substrates they are growing in are dewatered and become desiccated. In the same way, water level fluctuations and periodic dewatering in the main basin of Quabbin Reservoir prevent the establishment of macrophyte beds in most of the potential littoral zone habitat where substrates consist mostly of sand and gravel. Tributary inlets and quiescent coves are, to some degree, excepted from this pattern of desiccation due to their characteristic deposits of fine organic sediment. These deposits retain moisture and are often replenished by groundwater seepage, so plant tissues within exposed substrates can survive until the next inundation.

Results of Field Surveys of the Main Basin

Based on surveys conducted to date, the main basin of Quabbin Reservoir supports a sparse macrophyte community consisting of approximately 17 species (Table 2). All species present are native except for Variable Water-milfoil (*Myriophyllum heterophyllum*) which is indigenous to North America, but originally ranged west and south of New England so is considered alien. However, this species has long been established in Massachusetts and was recorded as the dominant macrophyte in Pottapaug Pond as early as 1973 (Gunner and Rho, 1977). It is the dominant macrophyte in relatively small areas of the main basin, mostly in the vicinity of Boat Areas #2 and #3, but does not grow over extensive areas at nuisance densities characteristic of more virulent invasive species.

One plant that has shown itself capable of persisting in the regime of periodic dewatering (discussed above) is a species within the large genus *Potamogeton* or "pondweeds." *P. bicupulatus* can be observed growing several feet tall from depths of 12 to 15 feet in scattered patches along otherwise barren littoral zone shorelines exposed to energetic wave action (Table 2). These patches were observed as part of the 2003 survey when water elevations were approximately 12 feet higher than during the previous growing season. Plants composing these patches represent individual specimens that had established themselves beyond the dewatered zone likely near the lower photosynthetic boundary of the littoral zone where, during periods of deep submergence, light becomes limiting.

The macroalga *Nitella* is another plant that occurs at depths beyond the zone of periodic dewatering. As an alga, this plant lacks roots and other structures typical of vascular plants, but has been observed forming a sparse network of growth over sediments at a variety of depths. It has occasionally been collected on anchors recovered from deep water in the main basin and likely is widespread throughout the reservoir system at depths beyond the limit of vascular macrophyte distribution.

Results of Field Surveys of Subsidiary Reservoir Components

Subsidiary components of the reservoir system, consisting of Pottapaug Pond and the Middle Branch Swift Impoundment, are located upstream of the main basin where they are isolated from extremes of water level fluctuation and periodic dewatering. Their littoral zones support extensive and luxuriant macrophyte beds typical of water bodies with relatively static water levels and having deposits of fine organic sediment.

Two species of *Potamogeton* or "pondweeds" and Variable Water-milfoil (*Myriophyllum heterophyllum*) dominate the macrophyte flora of Pottapaug Pond (Table 3A). Variable Water-milfoil (*Myriophyllum heterophyllum*) was recorded as the dominant macrophyte as early as 1973 (Gunner and Rho, 1977). In addition to the species listed in Table 3A, field notes from a survey conducted by Greg DeCesare of DEP on August 26, 1998 list the following taxa: *Decodon* (Water-willow), *Elatine* (Waterwort), *Eleocharis* (Spike-rush), *Elodea* (Waterweed), *Nitella* (macroalga), *Pontederia* (Pickerel Weed), *Sparganium* (Bur-reed), *Utricularia purpurea*, and *Utricularia vulgaris* (theses latter two species are both Bladderworts). These taxa are all common and endemic to Massachusetts and likely have simply been overlooked in more recent surveys.

Floating-leaved species consisting of *Brasenia scherebi* (Water-shield), *Nymphaea odorata* (White Waterlily), and *Nuphar variegata* (Yellow Waterlily) dominate the macrophyte flora of the Middle Branch Swift Impoundment (Table 3B). Variable Water-milfoil (*Myriophyllum heterophyllum*) is also present in this impoundment, but is restricted to scattered patches of growth. In addition to the species listed in Table 3B, the following emergent species were observed: *Ponterderia cordata* (Pickerel Weed), *Iris versicolor* (Blue Flag), *Typha* sp. (Cattail), and *Juncus* sp. (Rush).

Future macrophyte monitoring and alien scouting efforts should prioritize these two upstream components of the Quabbin Reservoir system due to their susceptibility to colonization by alien species from source populations in the Middle and East Branch Swift River watersheds and the ideal growth conditions they present to pioneering infestations of such species.

References Cited

Crow, G. E. and C. B. Hellquist. 2000. Aquatic and Wetland Plants of Northeastern North America, Volumes 1 and 2. The University of Wisconsin Press.

Geosyntec Consultants, Inc. 2006 (November). 2006 Quabbin Reservoir/Ware River Aquatic Macrophyte Assessment. Prepared for Massachusetts Water Resources Authority.

Gunner, H. B. and J. Rho. 1977 (June). The Relationship of Lake Quality to Specific Urbanization Stresses. Water Resources Research Center. Univ. of Massachusetts at Amherst. Publication No. 88. Completion Report Project No. B-047-MA.

Table 2 - Macrophyte Flora of the Quabbin Reservoir System: Main Basin

SPECIES NAME	COMMON NAME	DISTRIBUTION
Brasenia schreberi	Water-shield	uncommon, patchy
Eleocharis acicularis	Spike-rush	forms a dense, low "carpet" over extensive areas of substrate in coves and depositional areas protected from wave action
Eriocaulon sp.	Pipewort	uncommon, patchy, in quiescent coves and stream inlets; shallow water
Hypericum boreal	St. John's-wort	patchy, in quiescent coves and stream inlets; shallow water
Ludwigia palustris	Water-purslane	patchy, in quiescent coves and stream inlets; shallow water
Myriophyllum heterophyllum (alien species; see report text)	Variable Water-milfoil	dense patches of growth in Boat Areas #2 and #3, in channel to Shaft 11A, and in embayment located west of Pittman and Rattlesnake Hills (out from mouth of Moosehorn Brook inlet)
Najas flexilis	Naiad	uncommon, patchy
Nitella sp.	macroalga	patchy, often at depth
Nymphaea odorata	White Waterlily	uncommon, patchy
Potamogen bicupulatus	Pondweed	scattered along some exposed shorelines, often in deep water (12 to 15 feet; below 2002 minimum drought elevation)
Potamogen epihydrus	Pondweed	uncommon, patchy
Potamogen pulcher	Pondweed	uncommon, patchy
Proserpinaca palustris	Mermaid-weed	rare, patchy in Shaft 11A channel
Sagittaria graminea	Arrowhead	uncommon, patchy, in quiescent coves and stream inlets; shallow water
Utricularia intermedia	Bladderwort	uncommon, patchy, in quiescent coves and stream inlets; shallow water
Utricularia purpurea	Bladderwort	uncommon, patchy, in quiescent coves and stream inlets; shallow water
Utricularia radiata	Bladderwort	uncommon, patchy, in quiescent coves and stream inlets; shallow water

Table 3A - Macrophyte Flora of the Quabbin Reservoir System: Pottapaug Pond

SPECIES NAME	COMMON NAME	DISTRIBUTION
Brasenia scherebi	Water-shield	common, but patchy
Eriocaulon sp.	Pipewort	uncommon, patchy
Gratiola aurea	Golden-pert	patchy along waterline
Myriophyllum heterophyllum (alien species; see report text)	Variable Water-milfoil	abundant, widespread
Nuphar variegata	Yellow Waterlily	common, but patchy
Nymphaea odorata	White Waterlily	common, but patchy
Nymphoides cordata	Floating-heart	common, but patchy
Potamogen epihydrus	Pondweed	abundant, widespread
Potamogeton robbinsii	Pondweed	abundant, widespread
Sagittaria graminea	Arrowhead	uncommon, patchy
Utricularia intermedia	Bladderwort	common

Table 3B - Macrophyte Flora of the Quabbin Reservoir System: Middle Swift Impoundment

SPECIES NAME	COMMON NAME	DISTRIBUTION
Brasenia scherebi	Water-shield	common and widespread
Eriocaulon sp.	Pipewort	common and widespread
Gratiola aurea	Golden-pert	common along waterline
Myriophyllum heterophyllum (alien species; see report text)	Variable Water-milfoil	uncommon, patchy
Nuphar variegata	Yellow Waterlily	common, but patchy
Nymphaea odorata	White Waterlily	common and widespread
Potamogen epihydrus	Pondweed	patchy
Potamogeton robbinsii	Pondweed	patchy
Potamogeton amplifolius	Pondweed	patchy
Utricularia intermedia	Bladderwort	common, but patchy
Utricularia radiata	Bladderwort	uncommon, patchy
Utricularia vulgaris (?)	Bladderwort	common, but patchy

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Table A21: CVA (WPS) Intake Giardia and Cryptosporidium Results, oocysts/100L

Method: USEPA Method 1623

Location	SAMPLE Date	Crypto Concentration (Oocysts/100L)	# Recovered	# Empty Oocysts	# with Amorphous Structure	# with 1 internal Structure	GIARDIA Concentration (cysts/100L)	# Recovered	# Empty Oocysts	# with Amorphous Structure	# with >= 1 internal Structures
WPS	11-May-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	24-May-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	07-Jun-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	05-Jul-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	18-Jul-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	02-Aug-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	16-Aug-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	29-Aug-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	12-Sep-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	26-Sep-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	12-Oct-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	25-Oct-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	29-Nov-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	02-Dec-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	27-Dec-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	10-Jan-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	24-Jan-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	07-Feb-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	21-Feb-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	07-Mar-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	20-Mar-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	03-Apr-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	18-Apr-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	02-May-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	15-May-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	30-May-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	13-Jun-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	27-Jun-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	18-Jul-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	25-Jul-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	08-Aug-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	22-Aug-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	05-Sep-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	19-Sep-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	03-Oct-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	18-Oct-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	31-Oct-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	14-Nov-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	28-Nov-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WPS	11-Dec-06	ND	ND	ND	ND	ND	2	1	ND	1	ND
WPS	26-Dec-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

WPS: Winsor Power Station

Reported concentration are in cysts/100L. ***Other results are reported as cysts/50L.***

ND= Not Detected

Memorandum

To: Bob Bishop
From: Yuehlin Lee
Date: May 7, 2007
Subject: Nutrient Results from Tributary Monitoring, March 2005 – January 2007

Since March 2005, the tributary monitoring program has included sampling and analysis of nutrient parameters in order to support Environmental Quality Assessment (EQA) work and to gather baseline nutrient data for long-term tributary monitoring. Samples were collected biweekly from sites designated as "EQA" sites, including seven EQA sites within the Quabbin Reservoir watershed and five EQA sites within the Ware River watershed. EQA sites were analyzed for nitrate, nitrite, total Kjeldahl nitrogen (TKN), and total phosphorus, as well as ultraviolet absorbance at wavelength 254 nm (UV_{254}) as a surrogate measure of organic matter content. For "core" monitoring sites, samples were analyzed for nutrients on a quarterly basis and for UV_{254} either biweekly (Ware River core sites) or not at all (Quabbin Reservoir core sites). Nutrient results for the seven EQA sites in the Quabbin Reservoir watershed, along with the core sites associated with the EQA subdistricts, are summarized in **Table 1**. Results for the five EQA sites in the Ware River watershed are similarly presented in **Table 2**.

Table 1. Nutrient concentrations in Quabbin Reservoir Watershed, March 2005 – January 2007, by subdistrict and sampling Station.

Sampling Station	**Nitrate (NO_3; µg/L)**		**Total Kjeldahl Nitrogen (TKN; µg/L)**		**Total Phosphorus (µg/L)**		**UV_{254} (Absorbance/cm)**	
	Range	Median	Range	Median	Range	Median	Range	Median
West Branch Swift River Subdistrict								
211*, Route 202	<5-106	50	98-356	215	<5-28	14	No data	
211E, Sibley	<5-100	20	44-292	152	<5-28	10	0.049-0.259	0.105
211F, New Boston	<5-118	21	<5-362	147	<5-30	12	0.027-0.470	0.135
211G, Cooleyville	16-138	52	38-283	109	<5-192	16	0.024-0.163	0.059
Hop Brook Subdistrict								
212*, Gate 22 Road	29-88	72	109-421	223	<5-59	18	No data	
212A, Gate 22	<5-142	29	57-333	164	<5-42	16	0.046-0.305	0.127
212B, Gate 24	<5-198	91	52-387	146	<5-56	15	0.039-0.217	0.100
Middle Branch Swift River Subdistrict								
213*, Gate 31	<5-84	16	186-430	283	8-32	23	No data	
213A, Fay Road	11-304	63	56-414	225	<5-43	19	0.064-0.430	0.158
213B, Elm Street	13-203	65	<5-359	150	<5-42	14	0.066-0.437	0.146

* Core sampling site. Samples for nutrient analysis collected quarterly; no samples analyzed for UV_{254}.

Table 2. Nutrient concentrations in Ware River Watershed, March 2005 – January 2007, by sampling station.

Sampling Station	Nitrate (NO_3; µg/L)		Total Kjeldahl Nitrogen (TKN; µg/L)		Total Phosphorus (µg/L)		UV254 (Absorbance/cm)	
	Range	Median	Range	Median	Range	Median	Range	Median
East Branch Ware River Subdistrict								
108*, Intervale Rd.	6-48	21	239-536	343	10-49	25	0.128-0.468	0.269
108A, Route 68	<5-88	19	182-636	329	<5-64	19	0.127-0.488	0.247
108B, Cushing Pond Outlet	<5-168	75	<5-728	449	5-46	20	0.090-0.363	0.242
108C, Bickford	<5-209	35	<5-268	199	<5-16	10	0.057-0.177	0.093
116, Comet Pond	<5-45	<5	<5-318	179	<5-16	6	0.040-0.084	0.054
116B, Comet Pond Outlet Trib.@Rte.62	<5-27	<5	<5-890	367	8-112	30	0.129-0.859	0.340

* Core sampling site. Samples collected quarterly for nutrient analysis and biweekly for UV_{254} analysis.

Nutrient results from the 2005 tributary monitoring program were previously discussed in Scott Campbell's memorandum of March 27, 2006. Overall, the nutrient results in 2006 are relatively similar to those of 2005. It should be noted that nutrient monitoring in 2005 did not start until late March, whereas the 2006 monitoring included the full year. Additionally, in 2006, sampling at the Quabbin core sites did not occur quarterly as intended because of logistical problems (*i.e.*, missing bottles).

Previous efforts to evaluate nutrients in the Quabbin Reservoir and Ware River tributaries included a one-year study from April 1989 through April 1990. This study was conducted jointly by the Department of Environmental Protection, Division of Water Pollution Control (DEP), and the Metropolitan District Commission, Division of Watershed Management (MDC; predecessor to the DCR Office of Watershed Management) and provided a comprehensive evaluation of water quality, including metals, nutrients, and hydrologic budgets (DEP/MDC, 1992). However, the nutrient analyses were somewhat limited by the laboratory techniques available at the time of this study, without the "sensitivity or reliability" needed for evaluating the tributaries in these watersheds (Worden, 2000). Detection limits in the 1989-1990 study were 0.02 mg/L (20 µg/L) for nitrates and 0.005 mg/L (5 µg/L) for phosphorus (DEP/MDC, 1992). The detection limit for TKN was not stated in the report, but it appeared that TKN was detected in all sites at concentrations of 0.03 mg/L (30 µg/L) or greater.

In 1998, a one-year study was undertaken by MDC and the University of Massachusetts Environmental Engineering Program to evaluate nutrients and natural organic matter in Quabbin Reservoir (Worden, 2000; Garvey *et al.*, 2001). Nutrients were monitored at the major tributaries to the Quabbin Reservoir from October 1998 through September 1999. Samples for the 1998-1999 program were collected monthly at the mouth of each tributary, so the 1998-1999 sites are comparable to some of the core sites monitored today. Detection limits were 5 µg/L for

nitrates and 5 µg/L for total phosphorus, but the TKN detection limit was much higher, at 0.6 mg/L (600 µg/L). Nutrient results from the 1998-1999 sampling program are summarized for the West Branch Swift River, Hop Brook, and Middle Branch Swift River in **Table 3**. Comparison to previous nutrient monitoring suggests that phosphorus concentrations have increased, but further investigation would be needed to evaluate whether such changes are significant or what factors (*i.e.*, runoff) might account for these apparent increases.

Table 3. Nutrient concentrations for selected tributaries in Quabbin Reservoir Watershed, October 1998 – September 1999.

Sampling Station*	**Nitrate (NO_3; µg/L)**		**Total Kjeldahl Nitrogen (TKN; µg/L)**		**Total Phosphorus (µg/L)**		**UV_{254} (Absorbance/cm)**	
	Range	Median	Range	Median	Range	Median	Range	Median
West Branch Swift River	19-164	50	<600-1,190	<600	<5-20	12	0.031-0.165	0.077
Hop Brook	25-152	66	<600	<600	8-24	13	0.040-0.147	0.075
Middle Branch Swift River	<5-109	15	<600-714	<600	9-20	13	0.112-0.403	0.159

* Samples were collected near the mouth of the tributary.

Nitrogen

Compared to the 2005 results, the 2006 nutrient results indicate that nitrate results were slightly higher at several sites, with maximum or near-maximum concentrations occurring in February and/or March 2006, as well as in summer months of both years. In some cases, the median nitrate concentration also increased in 2006 compared to 2005. The apparent increase in nitrate concentration could be related to greater rainfall than expected in January 2006, or it may reflect the natural variability from year to year. It may also have more to do with the nutrient monitoring program not starting until late March 2005, thereby not capturing the peak nitrate values of late winter or early spring. In all cases, the nitrate concentrations remain far below the federal and state drinking water standard of 10 mg/L (10,000 µg/L), with median concentrations of 0.091 mg/L or less in all 12 EQA sites. When comparing the 2005-2007 data to the 1998-1999 data, the nitrate concentrations are relatively similar between the two data sets. The median value increased slightly in Site 212, while the maximum concentration decreased in 2005-2007 compared to 1998-1999.

Using a boxplot, **Figure 1** illustrates the variation in nitrate concentrations among the Quabbin Reservoir, Ware River, and Wachusett Reservoir watersheds. A boxplot provides a graphical representation of the data range and variability. The maximum, median, and minimum values for each site are shown as individual points. The box represents the middle 50 percent of the data (*i.e.*, values between the 25th and 75th percentiles), indicating whether the values tended to vary from the median value. Through boxplots, data range and variability can be compared easily among several sites. The number of samples by site is indicated by N. In general, it appears that nitrate concentrations are slightly higher in the Quabbin sites compared to the Ware River sites, but probably not significantly. The lower nitrate concentrations in the Ware River sites could be related to the greater percentage of wetlands in the Ware River watershed, where biological activity would likely include uptake of nitrate, thereby decreasing the nitrate concentration in water (Campbell, personal communication). Nitrate concentrations in both

Quabbin and Ware River watersheds appear comparable with three of the least developed sites in the Wachusett Reservoir watershed, as shown in **Figure 1**.

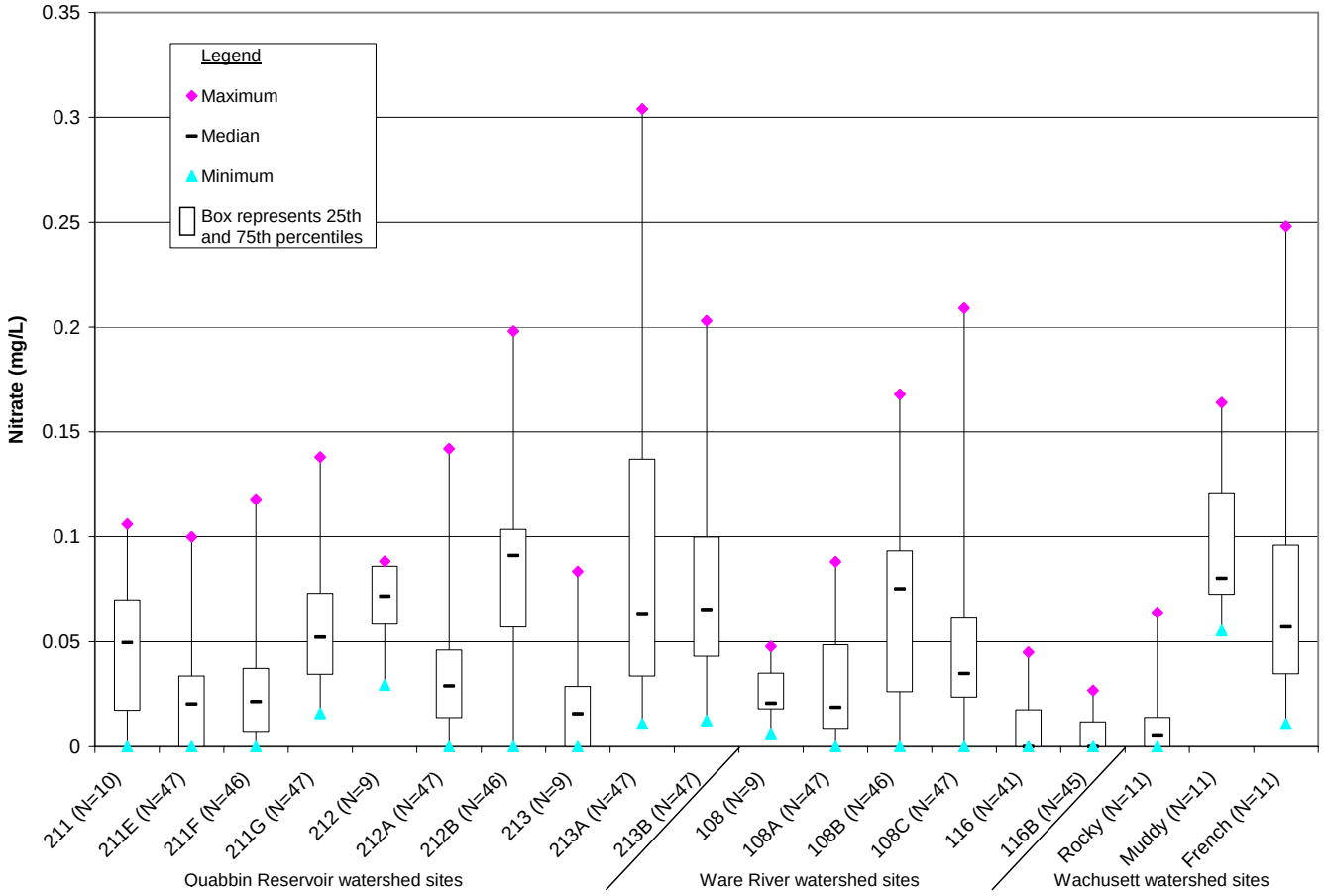

Figure 1. Boxplot of nitrate concentrations at selected sites in the Quabbin Reservoir, Ware River, and Wachusett Reservoir watersheds. N is the number of samples collected March 2005 through January 2007.

As discussed in Scott's March 27, 2006, memorandum, nitrite was detected at only one site in 2005 (0.00768 mg/L, or 7.68 µg/L, at Site 213 on September 27, 2005) and most likely resulted from the reduction of nitrate under anaerobic conditions. In 2006, nitrite was detected only at the Ware River Shaft 8 Intake (Site 101), with a result of 0.00542 mg/L (5.42 µg/L) on April 18, 2006. The dissolved oxygen concentration at the time of sampling remained relatively high, 12.6 mg/L, and decreased to 8.73 mg/L on the following sampling date, two weeks later, on May 2, 1006. It is unclear where the nitrite might have originated, based on site conditions of good flow and relatively high dissolved oxygen. In any case, both detections of nitrite were far below the federal and state drinking water standard of 1 mg/L (1,000 µg/L).

Nitrate and nitrite are inorganic forms of nitrogen. TKN measures the total organic nitrogen plus ammonia (and/or ammonium, depending on pH) of a water sample. Based on the pH typically observed in the Quabbin Reservoir and Ware River watersheds, ammonium would be the predominant species in tributary samples. Ammonia, which is not analyzed on a regular basis, was detected in Site 211E, Site 211F, and Site 211G at low concentrations of 0.012 mg/L (12

µg/L) or less, mostly in January 2007. Although ammonia is not routinely monitored, it can be assumed that the TKN for environmental samples represents predominantly organic nitrogen in these two watersheds. Comparing 2006 data to 2005 data, the maximum concentrations of TKN increased slightly at Site 212A, Site 213A, Site 116, and Site 116B. The median TKN values, however, decreased at all but two sites (Site 116 and Site 116B), and the difference for those two sites does not appear significant. As shown in **Figure 2**, TKN concentrations in the Ware River watershed appear to be elevated compared to the Quabbin Reservoir watershed, which may be related to the greater influence of wetlands in the Ware River sites. No TKN data are available for the Wachusett sites because TKN is not monitored there.

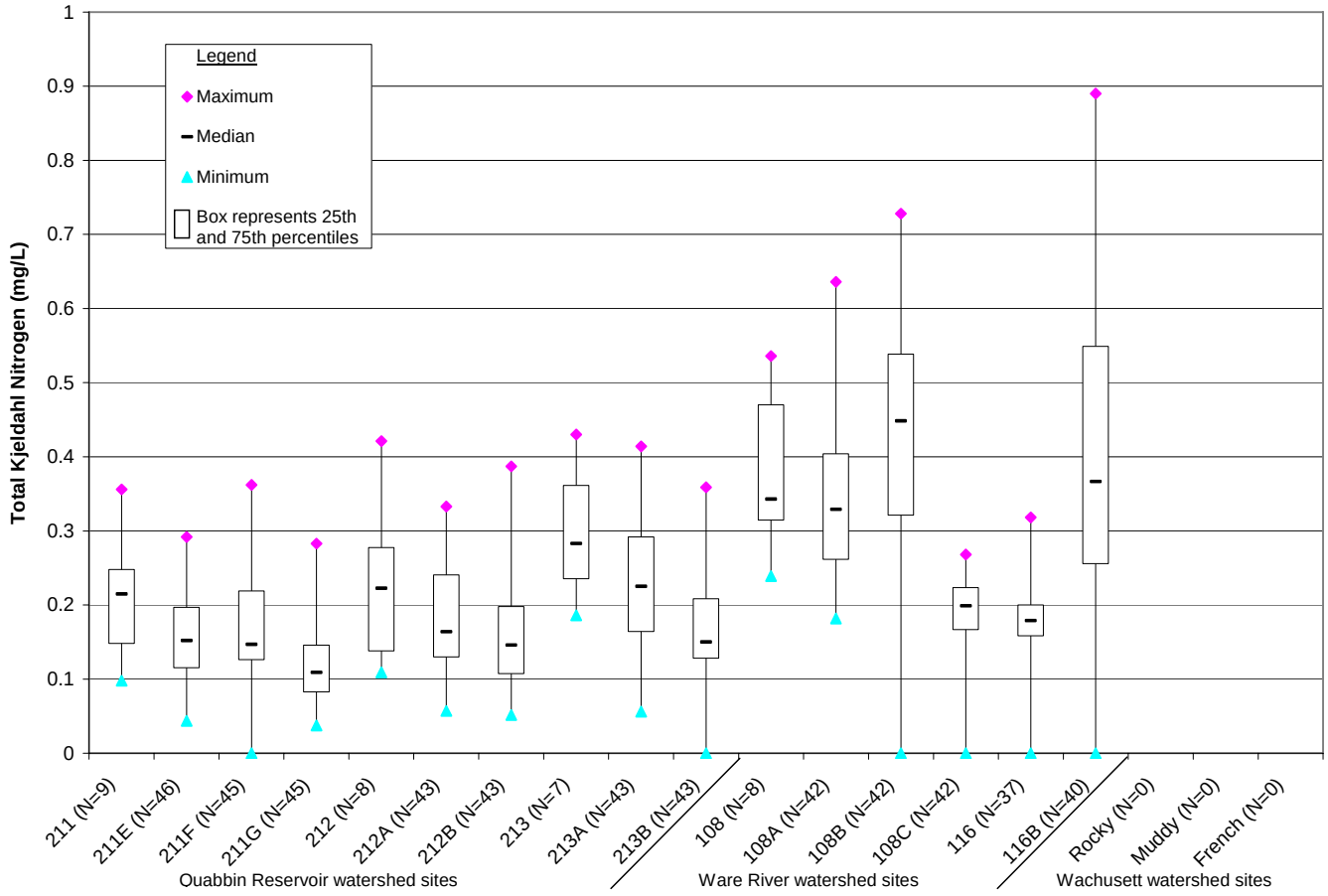

Figure 2. Boxplot of total Kjeldahl nitrogen concentrations at selected sites in the Quabbin Reservoir, Ware River, and Wachusett Reservoir watersheds. N is the number of samples collected March 2005 through January 2007.

TKN was also monitored in the 1998-1999 sampling program, but the detection limit at the time (600 µg/L, or 0.6 mg/L, for TKN) was insufficiently sensitive to provide much meaningful data. It appears that maximum values were lower at Site 211 and Site 213 in 2005-2007, compared to the 1998-1999 data set. However, it is not known if sampling frequency (quarterly versus monthly) or other factors have led to this apparent decrease.

The EPA has recommended nutrient criteria based on ecoregions, which are geographical regions with similar natural characteristics, including "geology, physiography, vegetation,

climate, soils, wildlife, and hydrology" (U.S. EPA, 2001a). These nutrient criteria are intended as part of EPA's guidance to States and authorized Tribes in developing ambient water quality standards that are protective of aquatic life and waterbodies' designated uses. The ecoregional water quality criteria were developed using various datasets from 1990-2000 and calculated from the 25th percentile value of all nutrient data for the ecoregion. The 25th percentile value from all sites represents the approximate value that would likely be found for the 75th percentile (greater than the majority) of pristine or minimally impacted waters. See EPA (2000, 2001b, or 2001c) for further details.

While not enforceable, these criteria may be useful as benchmarks in evaluating where nutrient concentrations could become a concern. The Quabbin Reservoir and Ware River watersheds have been classified as part of the Northeastern Highlands, within Ecoregion VIII, and the Northeastern Coastal Zone, within Ecoregion XIV. Based on these classifications, for rivers and streams, the total nitrogen guideline concentration is 0.38 mg/L (380 µg/L) for Ecoregion VIII and 0.71 mg/L (710 µg/L) for Ecoregion XIV. For Site 116, where samples are collected at the spillway of Comet Pond, the ecoregional nutrient criteria for lakes and reservoirs may be more appropriate; the guideline concentration for this site in Ecoregion XIV is 0.32 mg/L (320 µg/L).

Since total nitrogen is comprised of organic plus inorganic nitrogen (ammonia, ammonium, nitrate, and nitrite), the total nitrogen at each sampling site can be calculated from the TKN, nitrate, and nitrite data. Using this calculation, all but one of the sampling sites in the Quabbin Reservoir and Ware River watersheds remained below the total nitrogen guideline concentration, based on ecoregional classification, at least 75 percent of the time. Only at Site 108B was the total nitrogen guideline concentration exceeded during a majority of sampling events. However, it is not clear if nitrogen is excessive at the site, since the site appears to be located in a more transitional area between Ecoregion VIII and Ecoregion XIV. In addition, the water quality at this site may be more characteristic of wetland influence, for which case the nutrient criteria have not yet been developed. Overall, it appears that nitrogen concentrations have remained relatively low and stable in the EQA sites monitored during 2005-2007.

Phosphorus

The phosphorus concentrations in 2006 do not appear to be significantly different from those of 2005, based on the median values and overall range of concentrations. New maximum values were recorded at Site 212A and 213A in 2006, while the median concentrations decreased. During the 2005-2007 monitoring program, phosphorus concentrations at most EQA sites remained below 0.050 mg/L (50 µg/L). As shown in **Figure 3**, the phosphorus concentrations in the Quabbin Reservoir and Ware River watersheds are somewhat comparable to those in low-development areas of the Wachusett Reservoir watershed.

Previous EPA water quality criteria (1986) included a guideline concentration of 0.050 mg/L (50 µg/L) as phosphates for limiting nuisance algal growth. However, recent EPA guidance (2000, 2001b, 2001c) has recommended ecoregional total phosphorus criteria that would likely be more stringent for Massachusetts and most of the New England region. Guideline values on total phosphorus concentration for rivers and streams would be 10.00 µg/L (0.01000 mg/L) in Ecoregion VIII and 31.25 µg/L (0.03125 mg/L) in Ecoregion XIV. As discussed earlier, the lakes and reservoirs nutrient criteria may be more appropriate for Site 116, in which case the guideline concentration is 8.00 µg/L (0.00800 mg/L).

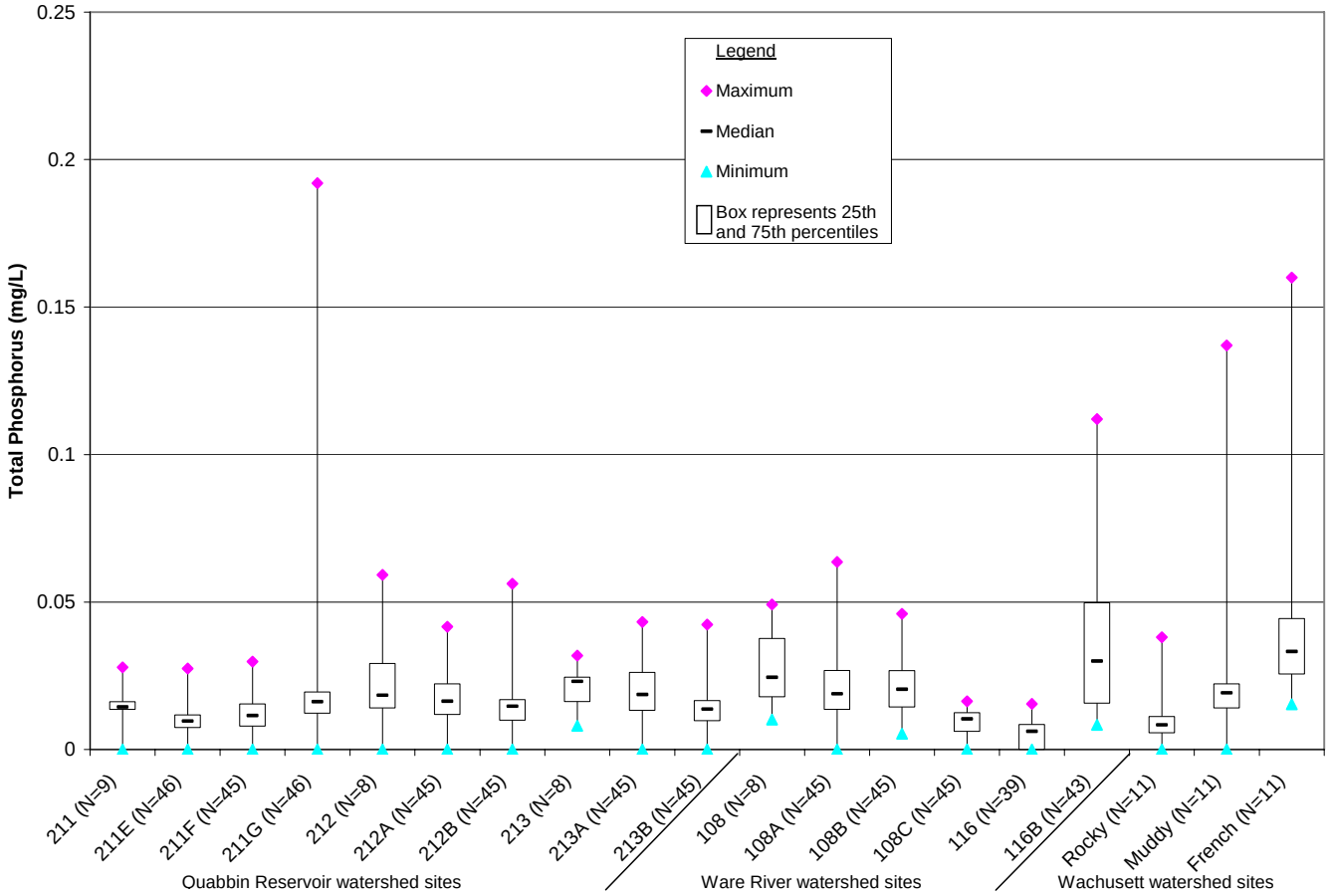

Figure 3. Boxplot of total phosphorus concentrations at selected sites in the Quabbin Reservoir, Ware River, and Wachusett Reservoir watersheds. N is the number of samples collected March 2005 through January 2007.

The total phosphorus criterion for Ecoregion VIII seems quite low compared to the concentrations observed in West Branch Swift River and Hop Brook during 2005-2007. Median values for sampling sites on these tributaries exceeded the Ecoregion VIII guideline value of 0.010 mg/L, with the exception of Site 211E, where the median value was very close to the guideline value. In the 1998-1999 data, median values for West Branch Swift River and Hop Brook also exceeded the 0.010 mg/L guideline value. Based on routine monitoring and EQA field work, these tributaries appear have minimal impacts from outside pollutant sources and are surrounded by large tracts of protected DCR land, and EQAs for the two subwatersheds have not uncovered any significant problems. Nutrient monitoring over a long term may show that the guideline value was set unreasonably low for Quabbin or Ware River watersheds; stormwater flow evaluation or macroinvertebrate surveys might also be useful if phosphorus concentrations appear to be trending upward.

The Middle Branch Swift River sites, in Ecoregion XIV, generally remained below the 0.03125 mg/L guideline value. Of the East Branch Ware River sites, Site 108 and Site 108A were generally below the 0.03125 mg/L guideline concentration, and Site 116B exceeded this concentration about half of the time. Site 116 appears to meet the total phosphorus criterion of 0.008 mg/L for lakes and reservoirs a majority of the time, while Site 108B exceeded the

Ecoregion VIII guideline value of 0.010 mg/L at least 75 percent of the time. As noted earlier, it is not clear if Site 108B truly has had excessive nutrient inputs or if the site would be better characterized as being in a wetland-influenced, transitional area between two ecoregions.

Total phosphorus was previously monitored in the 1998-1999 sampling program, when samples were collected at the mouth of each major tributary flowing into Quabbin Reservoir. Comparing the 2005-2007 data against the older data set, slight increases were noted for the median and maximum values at West Branch Swift River (Site 211), Hop Brook (Site 212), and Middle Branch Swift River (Site 213). It is difficult to determine if such increases are statistically significant, because the sampling programs were conducted under different sampling frequencies (quarterly/sporadically versus monthly) and probably without specific attention to hydrologic condition. If the samples were assumed to be representative of the water quality during each sampling program, it appears that the mean phosphorus concentration in the Middle Branch Swift River may have been significantly different ($p<0.05$) in 2005-2007 compared to 1998-1999. Further investigation may be warranted on this issue, since phosphorus is typically the limiting nutrient in freshwater.

UV_{254}

As noted at the beginning of this memorandum, UV_{254} is used as a surrogate measure of organic matter content in water. The primary concerns regarding organic matter, from a drinking water perspective, are the reactions that occur during chlorine disinfection. Organic matter increases the chlorine dosage needed for effective disinfection, and organic acids (derived from the decomposition of organic matter) react with chlorine to form disinfection byproducts (DBPs), many of which are known or suspected carcinogens. Therefore, to reduce chlorine use and the formation of DBPs, it is desirable to minimize watershed inputs of nutrients and organic matter to the drinking water source. For unfiltered source water supplies, DBPs may be a concern at UV_{254} values of greater than 0.050 cm^{-1} (Reckhow, personal communication). Water sources that are colored, eutrophic, or wetland-influenced may have UV_{254} values as high as 0.500 cm^{-1} (Reckhow, personal communication). Although none of the tributary sites are used directly as a drinking water source, the lower and upper values provide the range expected for the Quabbin Reservoir and Ware River tributaries.

Compared to 2005, the median UV_{254} values for 2006 decreased in the Quabbin Reservoir watershed, and those in the Ware River generally remained the same as in 2005. The maximum UV_{254} values increased at two locations, Site 212A and Site 108C, but otherwise the UV_{254} results were lower than or in the same range as in 2005. As shown on **Figure 4**, all of the EQA sites and associated core sites exceed the 0.050 cm^{-1} guideline value at least half of the time, with the median values ranging from 0.059 to 0.158 cm^{-1} in the Quabbin Reservoir watershed and 0.054 to 0.340 cm^{-1} in the Ware River watershed. Values at Site 116B exceeded 0.500 cm^{-1} occasionally, which may reflect the wetland nature and beaver activity near this sampling site. In **Figure 4**, the sites are listed generally from westernmost to easternmost across the graph. The UV_{254} values appear to increase in an easterly direction, partly because of greater wetland influence in the Ware River watershed, greater land development in the eastern part of the three watersheds, and greater land development in the Wachusett Reservoir compared to the other two watersheds (Campbell, personal communication).

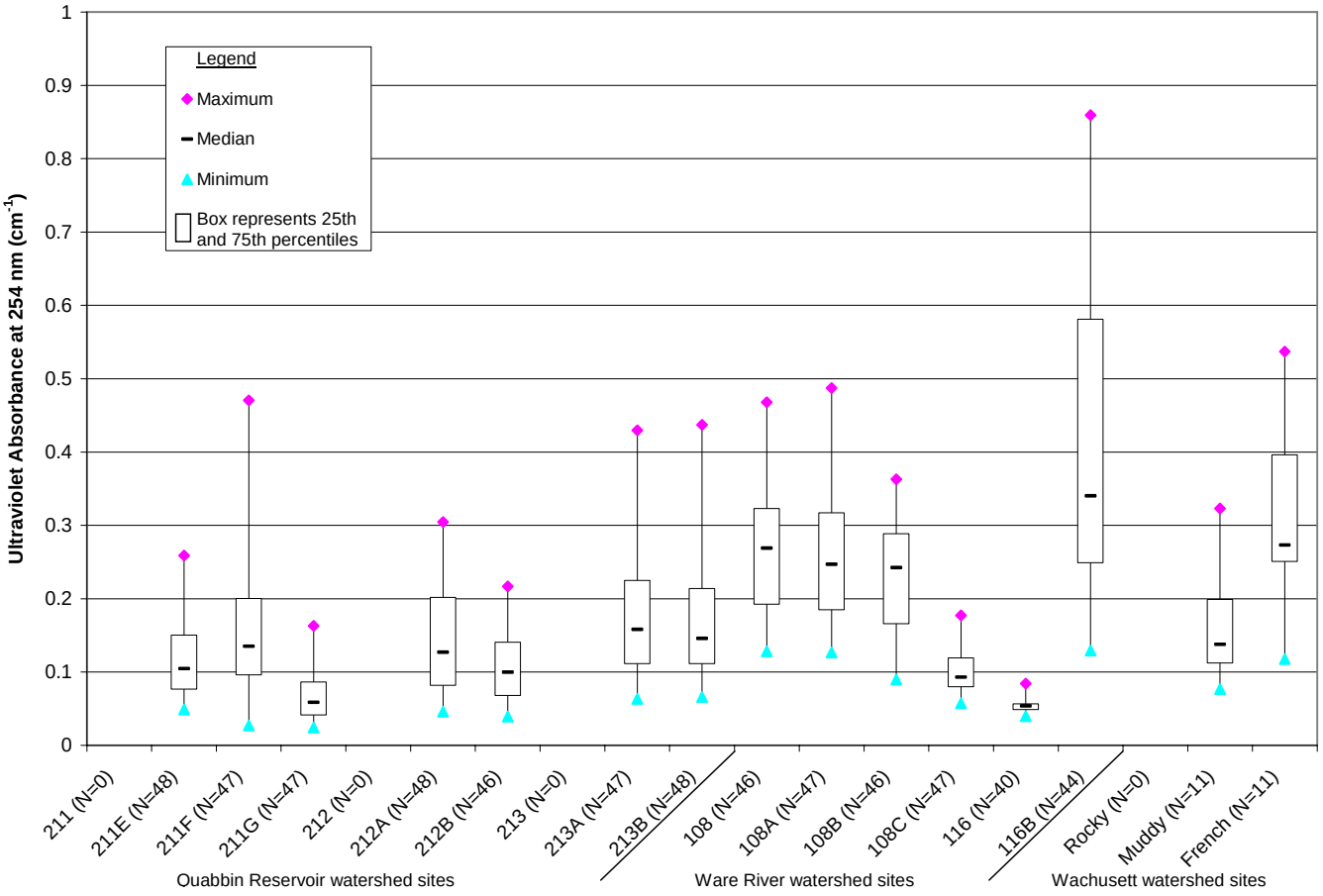

Figure 4. Boxplot of ultraviolet absorbance values at selected sites in the Quabbin Reservoir, Ware River, and Wachusett Reservoir watersheds. N is the number of samples collected March 2005 through January 2007.

UV_{254} data were also collected in the 1989-1999 sampling program at the mouth of each major tributary to Quabbin Reservoir. It was noted earlier that the core sites (Site 211, Site 212, Site 213, Site 215, and 216) are the closest and/or most similar sites for data comparison. In the 2005-2007 sampling program, however, samples from Quabbin watershed core sites were not analyzed for UV_{254}, so the results between the two sampling programs cannot be compared directly. **Figure 5** illustrates the range of values in the EQA sites (2005-2007 data) versus the sites at the tributary mouth (1998-1999 data).

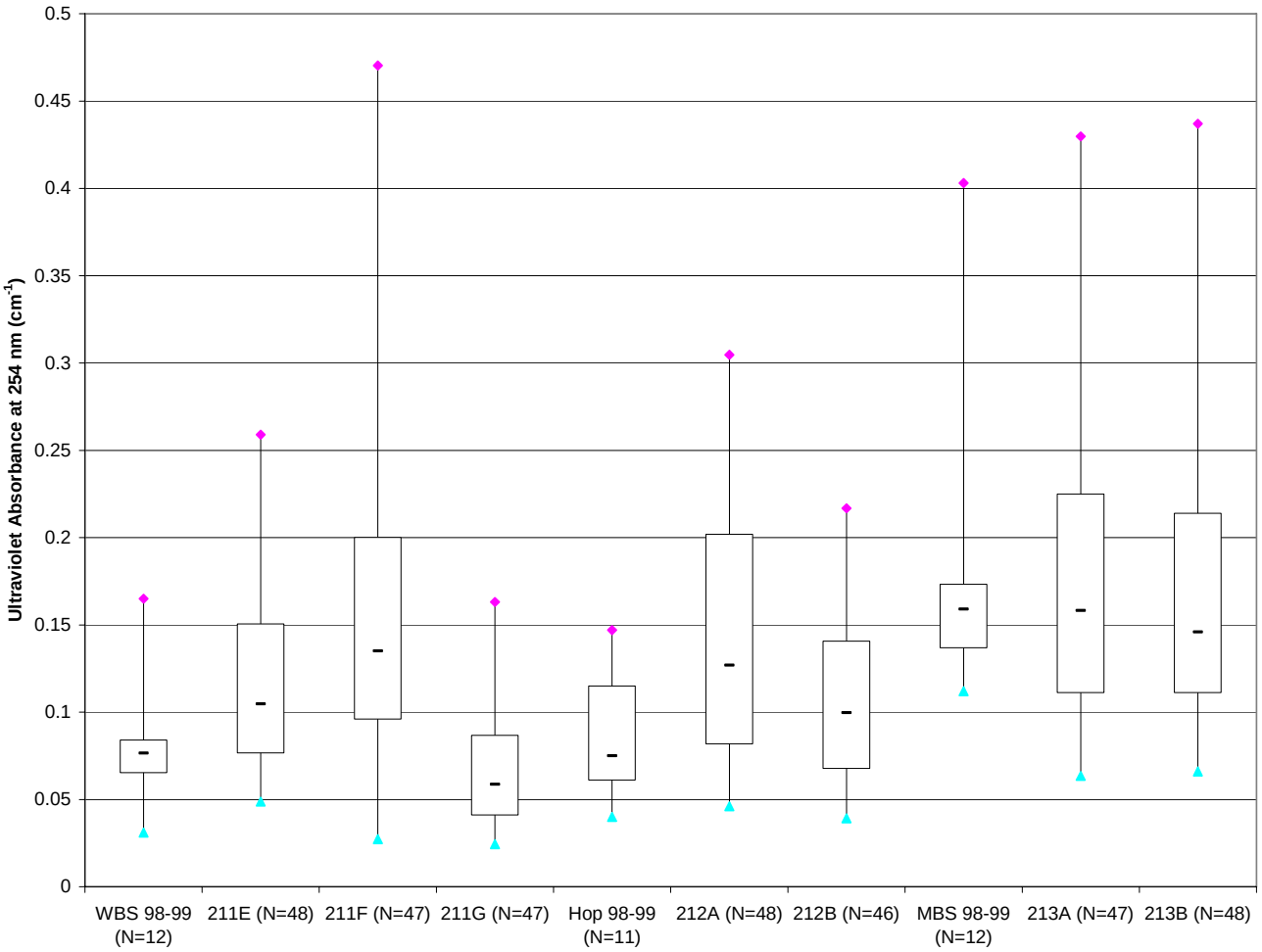

Figure 5. Boxplot of ultraviolet absorbance values at selected sites in the Quabbin Reservoir, watershed. West Branch Swift River (WBS), Hop Brook (Hop), and Middle Branch Swift River (MBS) data were collected October 1998 - September 1999. All other sites were collected March 2005 - January 2007. N is the number of samples.

Conclusions

Nearly two years of monitoring has provided a useful baseline for nutrient concentrations in the western tributaries of the Quabbin Reservoir watershed and in the East Branch Ware Subdistrict of the Ware River watershed. Overall, it appears that nitrate and nitrite were very low compared to drinking water standards, and total nitrogen concentrations generally remained below EPA's ambient water quality guidelines at least 75 percent of the time. The total phosphorus concentrations were generally lower than the 1986 water quality criterion of 0.050 mg/L (as phosphates) but periodically exceeded the ecoregional water quality criteria, which range from 0.008 to 0.03125 mg/L depending on ecoregion and waterbody type (*e.g.*, stream or lake; wetland criteria not yet available). It has not been determined whether concentrations above the ecoregional water quality criteria indicate any significant impairment in the Quabbin Reservoir or Ware River watersheds. These criteria are not enforceable at this time, but they indicate possible differences within the watersheds because of various ecoregional characteristics such as geology, soils, vegetation, or hydrology.

It is recommended that the nutrient monitoring program be continued, with changes, to gather additional baseline data for other parts of the Quabbin Reservoir and Ware River watersheds. The current 12 EQA sites can be discontinued so that different sites can be added within the eastern part of the Quabbin Reservoir watershed and within a Ware River subdistrict undergoing land development. A maximum of seven sites may be selected within the East Branch Fever, East Branch Swift, and subdistricts of the Quabbin Reservoir watershed, and a maximum of five sites may be selected within the Barre Falls, Mill Brook, and Rutland State Park subdistricts of the Ware River watershed.

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Reckhow, D.A. Professor, Department of Civil and Environmental Engineering, 18 Marston Hall, University of Massachusetts, Amherst, Massachusetts.

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Memorandum

To: File
From: Yuehlin Lee
Date: July 21, 2006
Subject: Inspection and Re-sampling at Sample Site 213A

Results from the July 18th (Tuesday) sampling indicated that Sample Site 213A had a fecal coliform concentration of 1,440 cfu/100 mL. The *E. coli* result was 1,660 cfu/100 mL, within acceptable range for comparison with the fecal coliform result. During sample collection, Peter Deslauriers noted that this site had a high pool and poor flow, with beaver activity the suspected source of fecal coliform. The last date of measurable rain was recorded on July 13th, and in the days prior to sampling, the weather conditions were hot and humid, reaching the low to mid 90s.

On Thursday, July 20th, I collected an additional sample from the same location and investigated upstream of the sampling site for obvious signs of fecal pollution. Weather conditions mid-day were low to mid-70s, cloudy, with a brief shower, then becoming partly sunny. Water upstream of Sample Site 213A was stagnant, with a slight scum on the surface, and appeared to be a few inches higher than on the downstream side of the bridge. The water on either side of the bridge was colored (brown) and cloudy. The wetland area north and west of Sample Site 213A appeared to be fairly extensive, and the water surface appeared to be within 1 to 2 feet of the road elevation. At the west side of the wetland, there appeared to be a relatively new area of inundation, and possibly a small beaver dam, about 6 inches high by 4 feet wide.

I investigated the stream condition about 1 mile upstream of Sample Site 213A, where Fairman Road crosses the "Saddle Branch" Swift River, in Orange. A beaver dam, about 3 feet high, was observed on the upstream side of the road crossing. See photo, below left. Good flow was observed flow over/through the dam. Based on the appearance of dead trees, the area upstream of the dam appeared to have flooded for several years.

I drove north towards Lake Mattawa and did not see anything unusual. I delivered the sample collected that morning to the MWRA Lab at Quabbin. See attached chain of custody and lab result. The fecal coliform concentration, 80 cfu/100 mL was much lower than on the original sampling result.

MEMORANDUM

Subject: COMET POND BEACH - HUBBARDSTON

Prepared by: Scott Campbell, DCR/ Division of Watershed Management, Belchertown, MA
Yuehlin Lee, DCR/ Division of Watershed Management, Belchertown, MA

Date: August 4, 2006

On August 2, 2006, Division of Water Supply Protection staff conducted a special sanitary survey and collected follow up water sampling in an attempt to quantify and determine the likely source of contamination that resulted in the unsafe water advisory posting issued on August 2, 2006. A survey was conducted on foot of the beach area and via boat of the shoreline area that flanks the beach to the north and south. Staff Environmental Engineer, Yuehlin Lee and I initiated the survey at 10:30 AM and completed sampling of the bathing water by 11:15 AM. Today's weather remained very hot and humid with the air temperature measured at 88°F and the surface water temperature measured at 85°F. A light, variable breeze was blowing very light waves into the shore of the beach. Preliminary test results from E. Coli and Enterococci sampling are conflicting, but, absent a gross pollution source it is believed that high bather load within a confined setting, and the week's extremely hot temperatures are contributing to elevated levels of both parameters. The regular presence of higher Enterococci levels (beach is close to exceeding the geomean standard) verses E. Coli levels measured on August 3 at twelve times below the safe water contact standard might suggest that the source of the Enterococci is localized and a naturally occurring, non-pathogenic subspecies. Further investigation of the beach sediments as a possible source and the speciation of Enterococci species could help to answer the questions on the reliability of using Enterococci levels for public health protection.

Beach Survey

The sand beach was recently raked and absent of any litter. The beach area was also notably absent of any goose droppings. The only signs of wildlife were a half dozen ducks wading in the water approximately 1/10 mile north of the beach. Water clarity was excellent as the water was free of turbidity and nuisance algae. On this day, the lifeguards on duty were informing visitors of the no swimming advisory and the number of visitors (6) was very light as a number of visitors immediately turned away from the beach when they heard about the water advisory. The lifeguard had informed me that during this extended period of very hot weather the number of visitors to the beach has routinely exceeded 200 daily. I observed that the roped area for swimming was noticeably smaller than in previous years and Ms. Denise Young, Area Attendant with the DCR, informed me that in fact the swimming area was reduced in size to comply with state regulations. A returning lifeguard that I spoke with also confirmed the reduction in size from last year and also pointed out that the number of visitors had also increased from last year. Two portable toilets are located by the parking area and both were reasonably clean though one unit had a depleted supply of hand sanitizer.

Photo: Comet Pond Beach, DCR/DWSP

Boat Survey

A small boat was used to inspect approximately 1/2 mile of shoreline that flanks the beach to the north and south. Absent a small group of ducks spotted nearby, there were no signs of problem wildlife as the shoreline was absent of beaver lodges and goose droppings. Shoreline vegetation was hacked down at locations in close proximity, north and south of the beach to accommodate shore fishing. These areas contained concentrated piles of litter that included bait cups, coffee cups and other miscellaneous trash. Both areas have DCR signs posted advising users of restrictions of land clearing and fires (photos below). The DCR might want to consider additional surveillance and regular patrols of the area to increase user awareness and ultimately compliance with DCR policies.

Photos: Shoreline area cleared for shore fishing, DCR/DWSP

Windshield Survey

Nine acres of pasture land abuts the shoreline at the extreme northern end of this 127-acre, principally spring-fed pond. On this day no cows were observed in the open fields, and it appears that the field is being cut for hay. Residential development on the pond is sparse with the greatest number of seasonal homes residing along the extreme southern end of the pond. No apparent problems were observed with the spattering of a small number of summer homes surveyed closest to the beach (homes within 1/3 mile radius to the beach). DCR staff have observed geese and their droppings on occasion at the southern end of the pond where the greatest density of year-round residences lies. DCR signage and routine patrols might be warranted to discourage feeding opportunities available to the geese. However, the remote proximity of the problem goose area to the beach suggests that it is unlikely that the geese are the source of recent contamination measured at the beach.

Photo: Empty pasture overlooking Comet Pond, DCR/DWSP

Water Quality Results

Single grab water samples were collected on August 3 from the left, right and middle region of the roped bathing area. The samples were collected when the bathing area was free of swimmers and water conditions were clear. A light breeze was blowing into the shore generating very light waves on the water surface. Water temperatures were very warm and ranged between 29.2°C and 30.1°C (84°F to 86°F). The samples were brought to Quabbin Laboratory and analyzed for

E. coli using the Colilert method and Fecal Coliform bacteria using membrane filtration. Results are highlighted in the table below.

Comet Pond Beach Sampling – August 3, 2006			
	Beach Left	Beach Middle	Beach Right
E. Coli	10 MPN/100mL	20 MPN/100mL	<10 MPN/100mL
Fecal Coliform	4 CFU/100 mL	4 CFU/100 mL	5 CFU/100 mL
Source: Quabbin Laboratory, MWRA			

The DCR has historically used both indicators as indicators of fecal contamination. In 2004, the U.S. EPA mandated that Enterococcus spp. (or E. Coli for freshwaters) replace fecal coliform as the new federal standard for water quality at public beaches. The use of these two new indicators for the tracking of bacterial sources is made difficult because both have the ability to survive long term in the soil environment, reported on the order of >60 days[1,2]. The significance of for public health is somewhat blurred because both organisms are present in non-pathogenic form at high concentrations in the natural environment (i.e. sediments, soil and plants). Research conducted on Lake Michigan attempted to investigate the reliability of these two indicator organisms as indicators of public health[3]. One noteworthy finding from this study of side by side sampling using the two indicators found that using Enterococci alone would have resulted in 56 additional unsafe-recreational-water-advisories compared to the total of using E. Coli alone. E. Coli results from Comet Pond Beach on August 3 were measured at levels nearly twelve times below the single-sample advisory level of 235 CFU/100 mL. With the conflicting test results, a limited range of data, and the absence of a gross pollution source more questions are raised concerning public health and the suitability of indicators. Additional speciation of the Enterococci species is advisable to fully understand the source (pathogenic verses natural) of the organisms and to determine if operational strategies may be needed to control the source (i.e. if sediment resuspension is the likely source can bather loads, lake bottom, etc.. be better managed to avoid turbidity).

References:

1. **UBIQUITY AND PERSISTENCE OF ESCHERICHIA COLI IN A MIDWESTERN COASTAL STREAM**
Muruleedhara Byappanahalli, Melanie Fowler, Dawn Shively, and Richard Whitman

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2. **PERSISTENCE OF ESCHERICHIA COLI IN RECREATIONAL COASTAL WATER AND SEDIMENT**
D.L. CRAIG, H.J. FALLOWFIELD AND N.J. CROMAR

http://catalogue.flinders.edu.au/local/adt/uploads/approved/adt
SFU20051108.093750/public/03Appendix_1.pdf

3. **ENTEROCOCCI AS INDICATORS OF LAKE MICHIGAN RECREATIONAL WATER QUALITY: COMPARISON OF TWO METHODOLOGIES AND THEIR IMPACTS ON PUBLIC HEALTH REGULATORY EVENTS**
Julie Kinzelman,[1,2*] Clement Ng,[3] Emma Jackson,[4] Stephen Gradus,[3] and Robert Bagley[1]
http://aem.asm.org/cgi/content/full/69/1/92

Attachment

2006 Comet Pond Outlet Microbiological Results			
Date	E. Coli (MPN/100mL)		Fecal Coliform (CFU/100mL)
January 10	<10		<2
January 24	<10		<2
February 4	<10		<2
February 21	<10		<2
March 7	<10		<2
March 21	<10		<2
April 4	<10		<2
April 18	<10		<2
May 2*	**374**		**388**
May 16	<10		9
May 30	40		<2
June 13	<10		<2
June 27	20		14
July 7	10		4
July 22	31		<2
August 8	<10		<2
Notes: *Site 116B on May 2 – E. Coli 10 / Fecal Coli 23 (mix-up in bottles?) Comments by Pete–Rain fell during sampling event, low flow at 116/116B			

Memorandum

To: File
From: Yuehlin Lee
Date: August 18, 2006
Subject: Inspection and Re-sampling at Boat Cove Sample Site

Results from the August 15th (Tuesday) sampling indicated that the Boat Cove sample had a fecal coliform concentration of 4,010 cfu/100 mL. The *E. coli* result was 6,130 mpn/100 mL. Light rainfall occurred during the morning of August 15th, with 0.37 inch of rain recorded at the Hangar weather station over 6 hours (0.40 inch at the weather station located south of the public parking lot). Rainfall intensity at the Hangar weather station ranged from 0.02 to 0.11 inch per hour. The previous date of measurable rain (0.02 inch over 40 minutes) was recorded on August 7th, and in the days prior to sampling, the weather conditions were generally sunny and dry, with daytime temperatures reaching the 70s and 80s.

On Thursday, August 17th, Peter Deslauriers and Yuehlin Lee collected an additional sample from the same location and investigated upstream of the sampling site for obvious signs of fecal pollution. Weather conditions mid-day were sunny with a few clouds, and air temperature in the mid-70s. No flow was observed at the outlet of Boat Cove Brook, downstream of the sample site. The sample site, located approximately 150 feet upstream of the brook outlet, had very low flow and was lower than during the August 15th sample collection. Some discarded paper napkins were noted along the access road downstream of the sample site.

Walking upstream along the main branch of the brook toward a pond, we observed deer tracks through the area. Three catbirds and coyote scat was seen downstream southwest of the pond. At the pond, another catbird was observed, along with a hummingbird, 22 painted turtles, and numerous frogs. No signs of beaver or muskrat were observed at the pond. Water level at the pond was low, with some exposed areas of mud, and a very slight flow was observed at the outlet of the pond. Leaving the pond area, we observed deer scat in an uphill area northwest of the pond. We inspected the secondary branch of Boat Cove Brook, where we observed deer tracks. There was no visible flow in this branch of the brook.

Our site inspection did not reveal significant wildlife impacts upstream of the sample site. The fecal coliform and *E. coli* results may have been elevated from storm runoff or from bank sediments being washed into the brook. The results of the repeat sample collected August 17th showed that fecal coliform concentration has decreased to 80 cfu/100 mL and *E. coli* concentration has decreased to 183 mpn/100 mL.

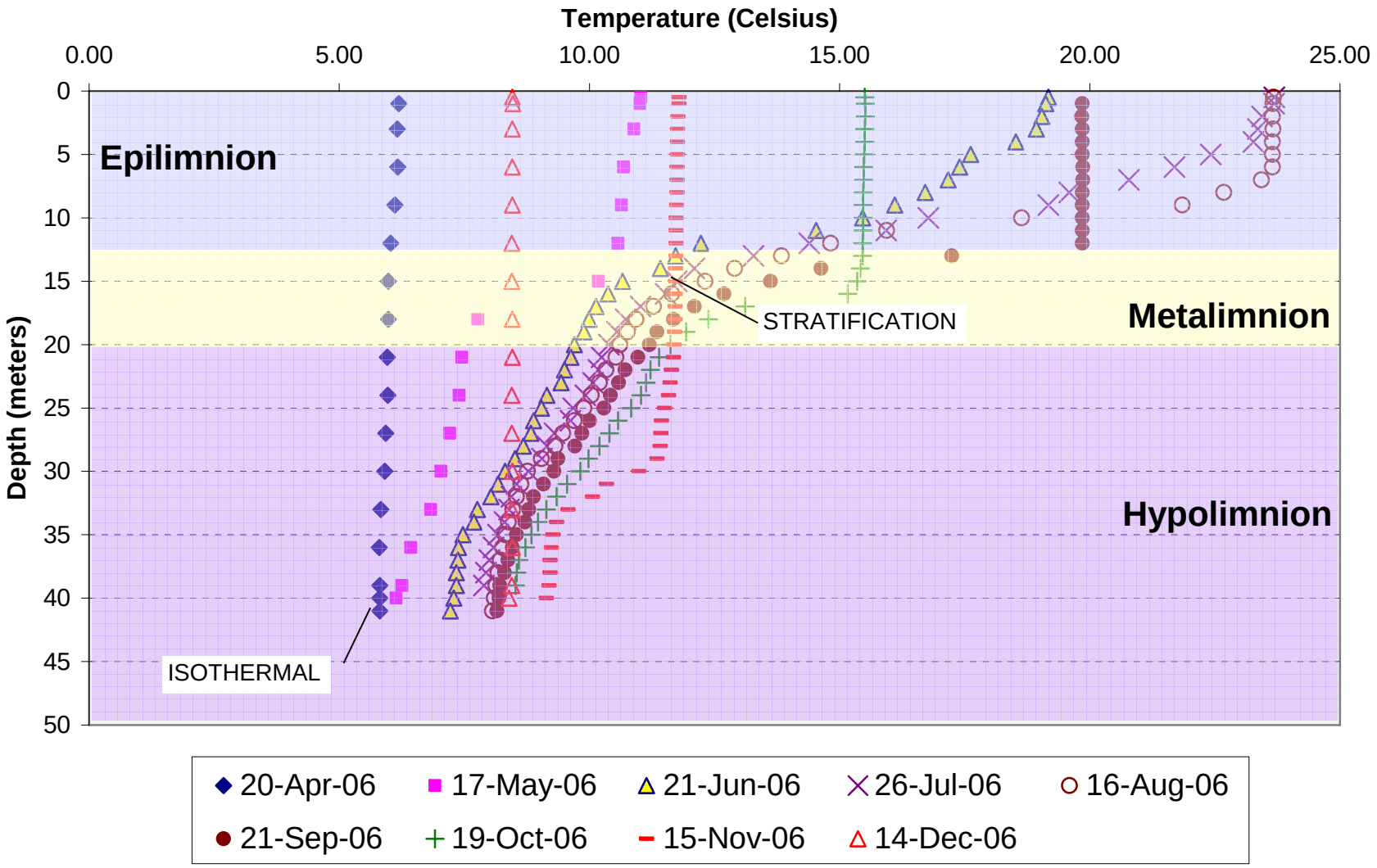
APPENDIX B

Selected Plots and Graphs

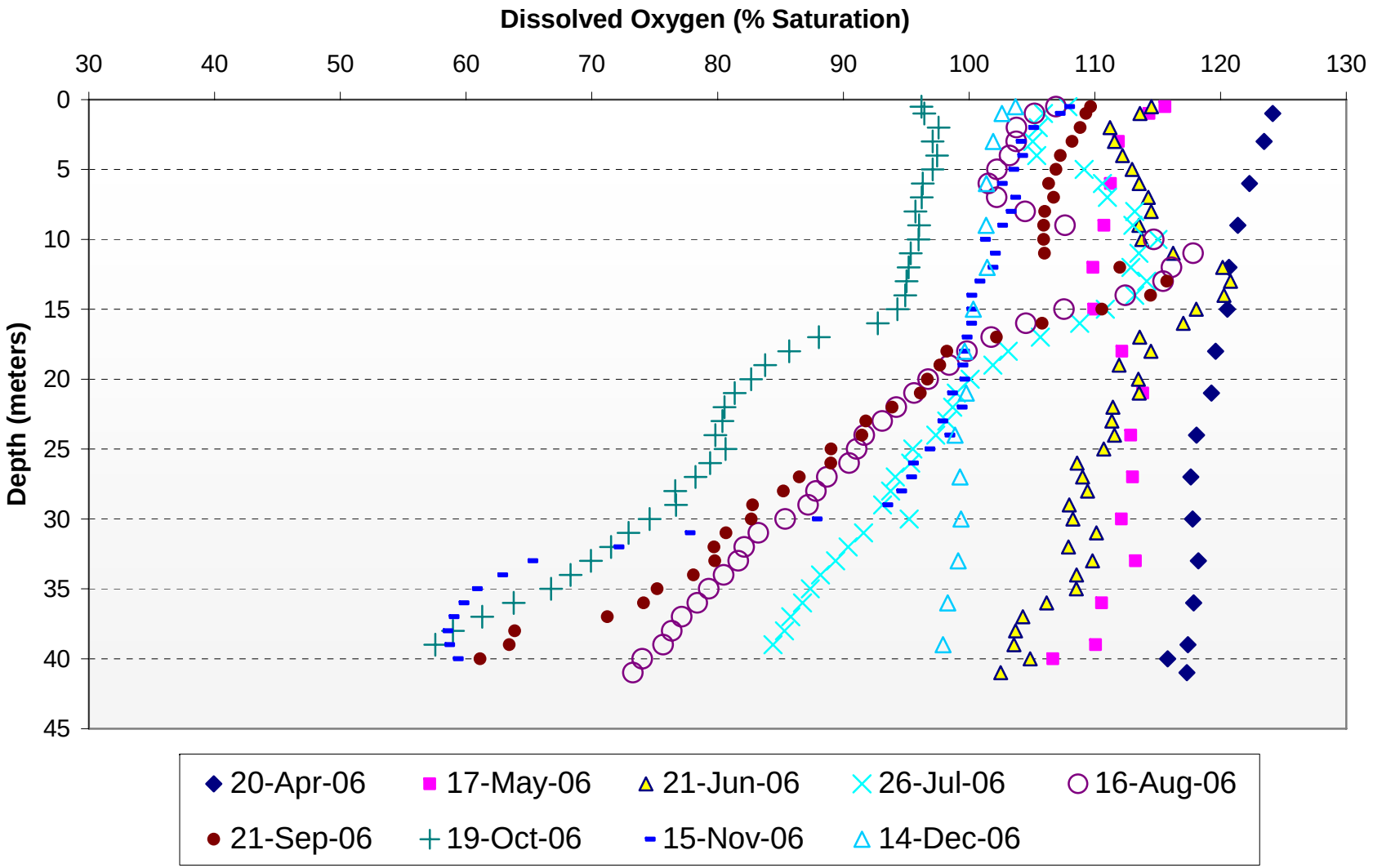
Quabbin Reservoir Profiles

Stream Hydrographs

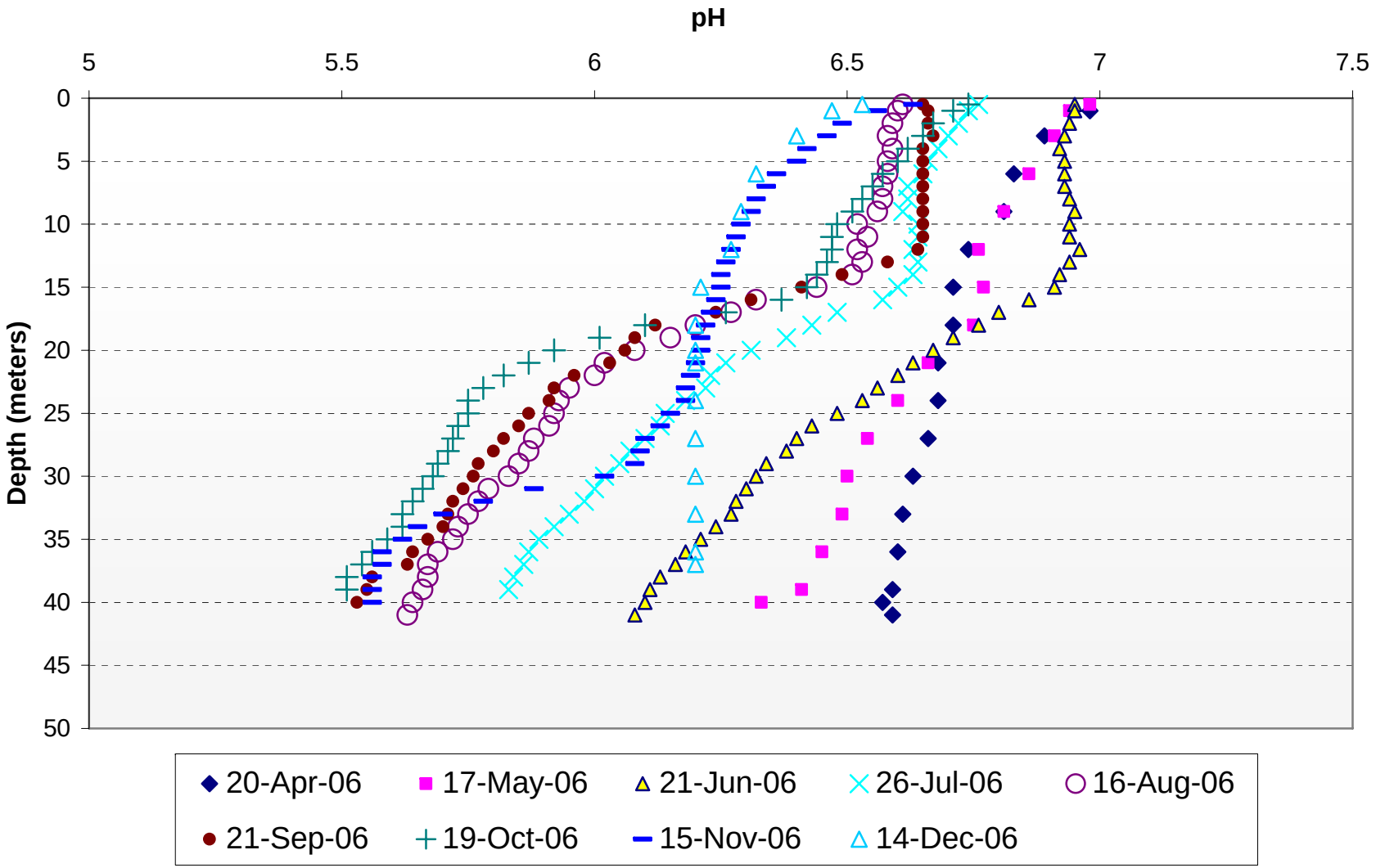
Site 202 - CY 2006 Temperature Profiles



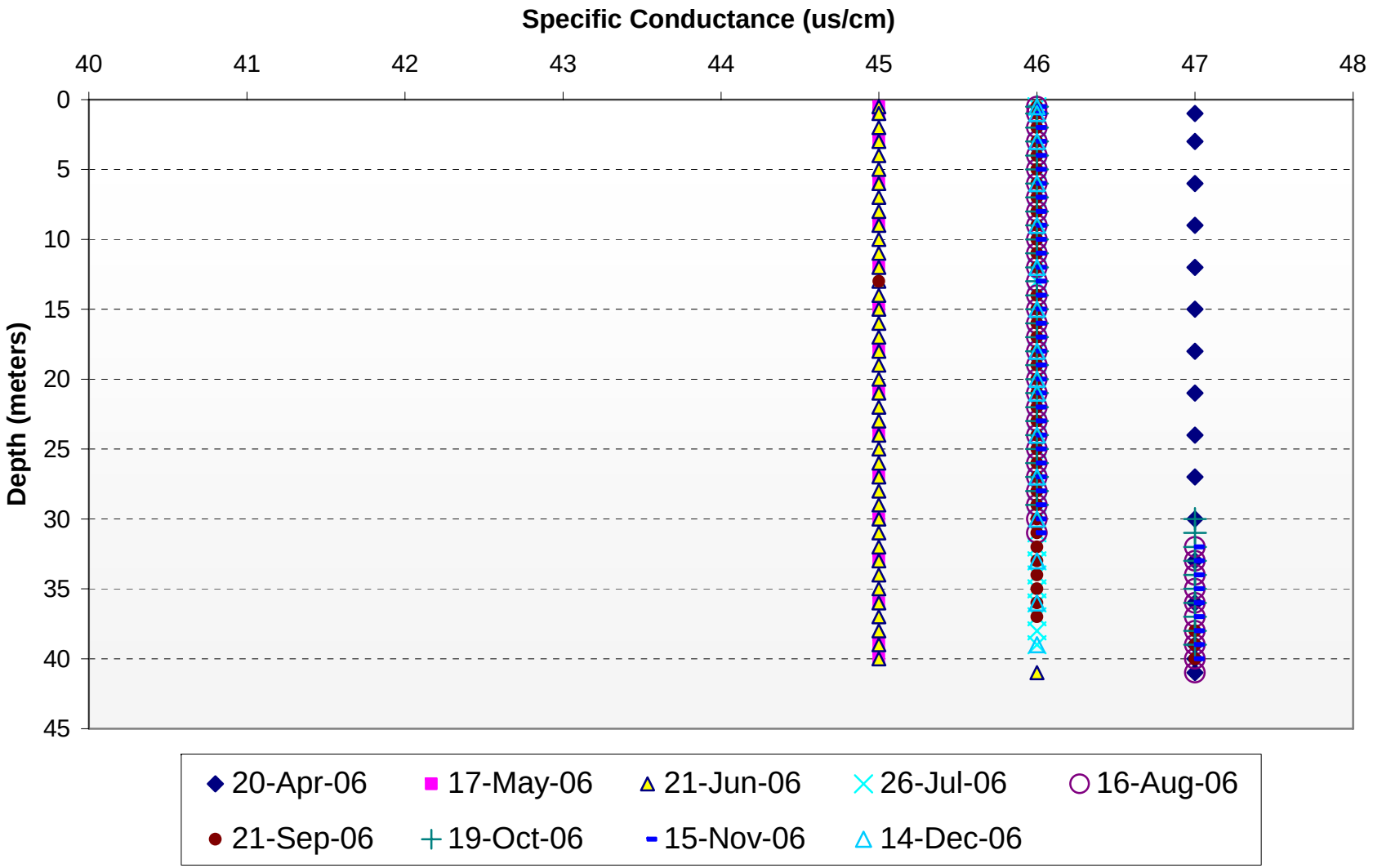
Site 202 - CY 2006
Dissolved Oxygen Profiles



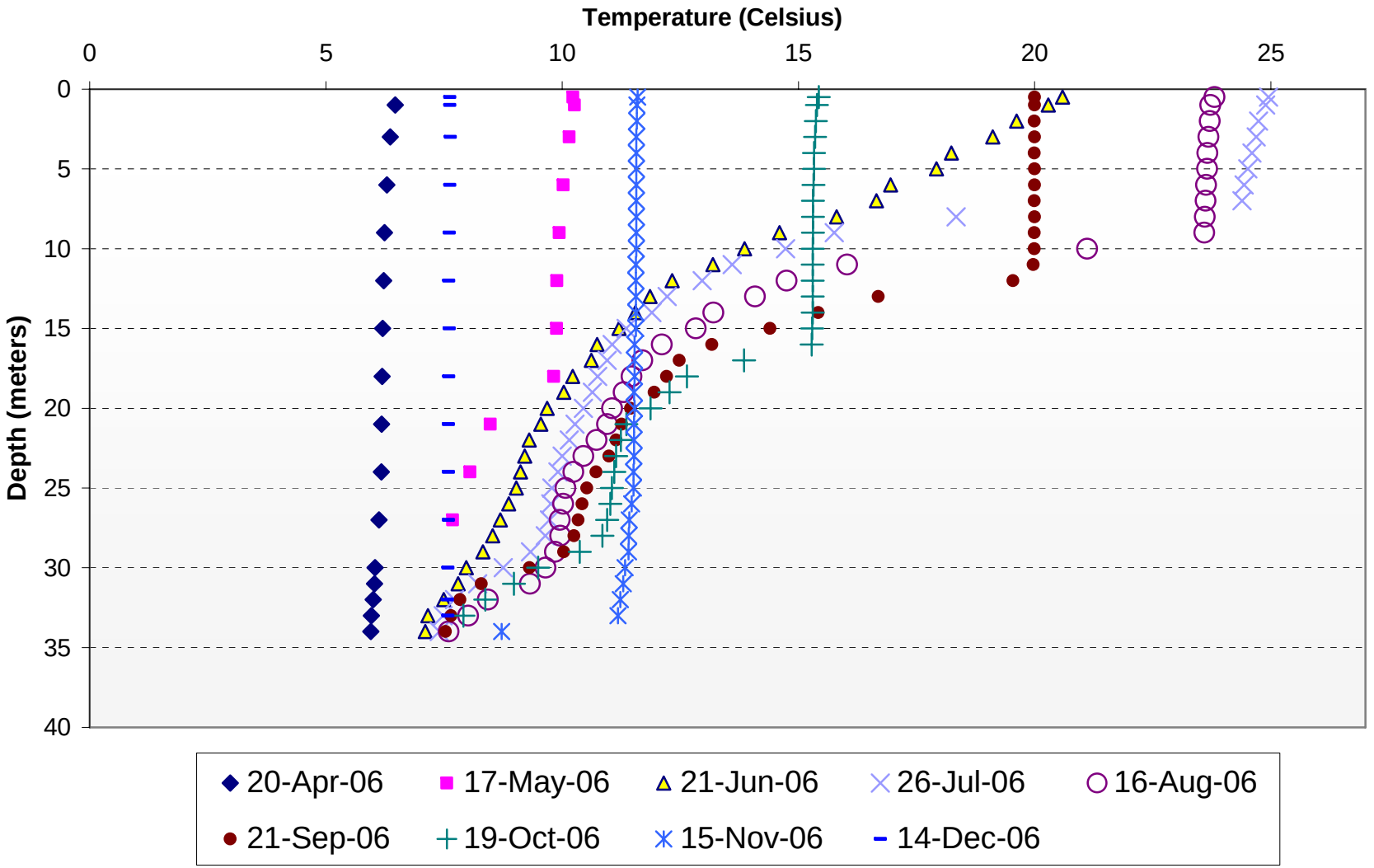
Site 202 - CY 2006 pH Profiles



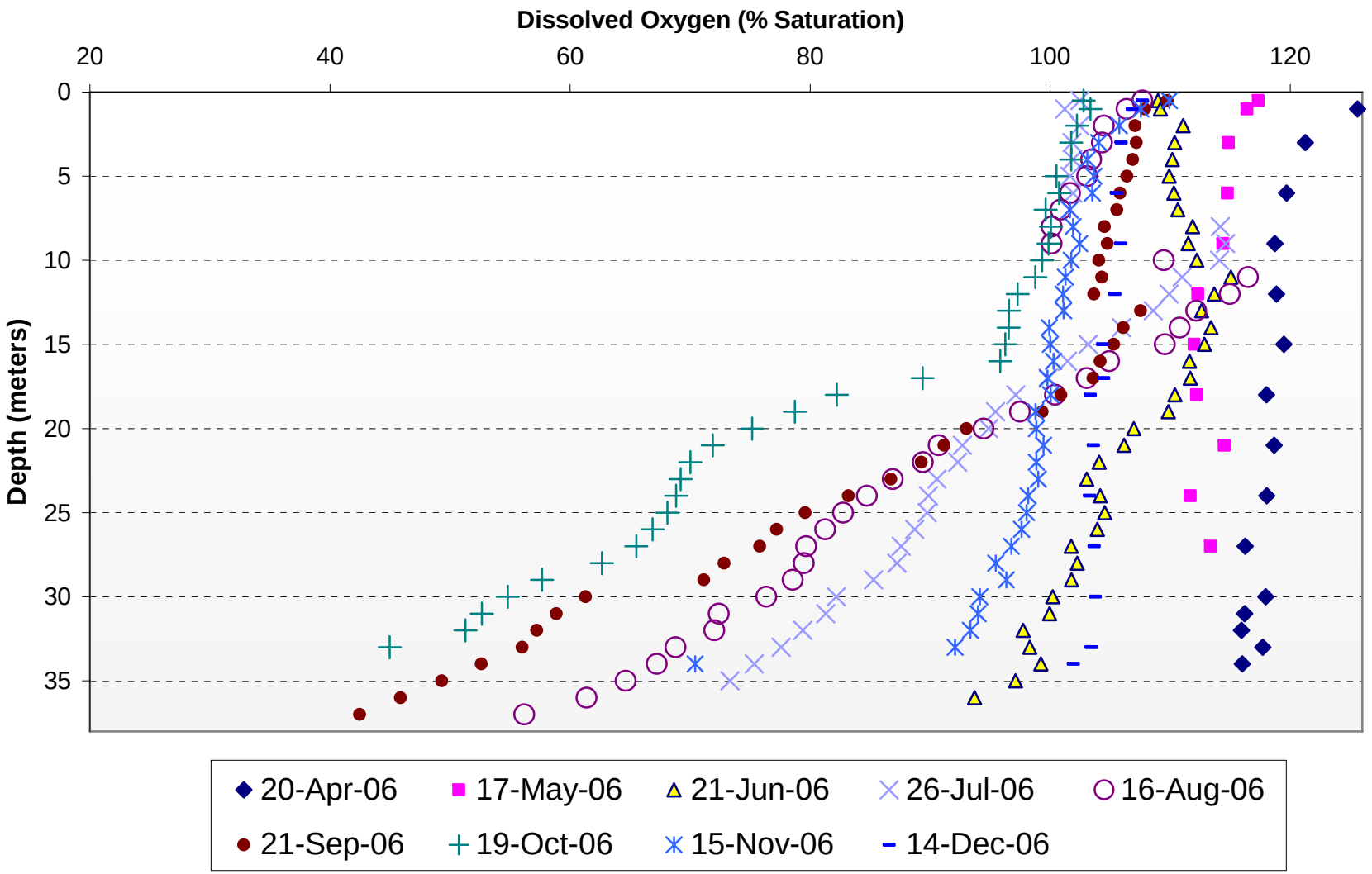
Site 202 - CY 2006 Specific Conductance Profiles



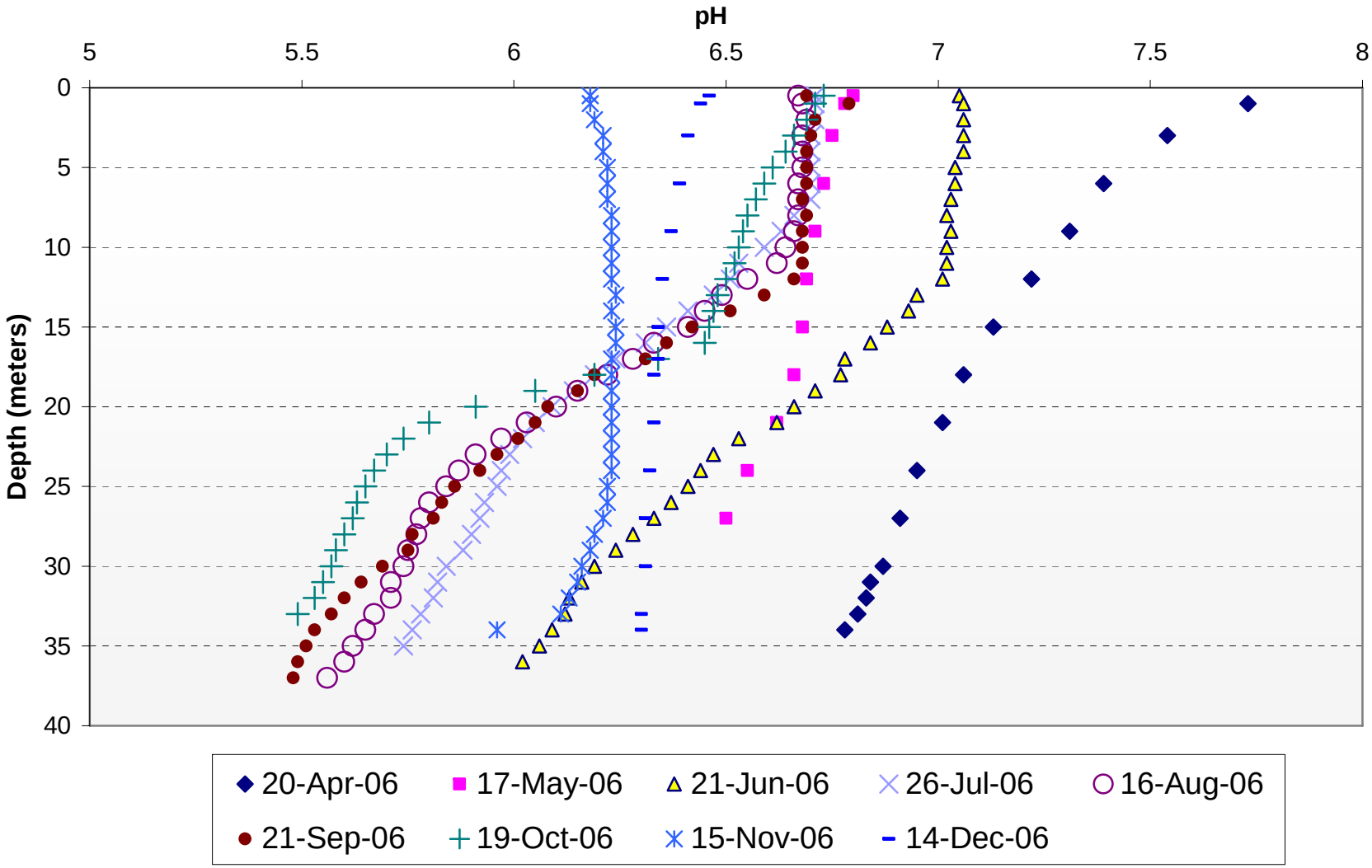
Site 206 (Shaft 12) - CY 2006 Temperature Profiles



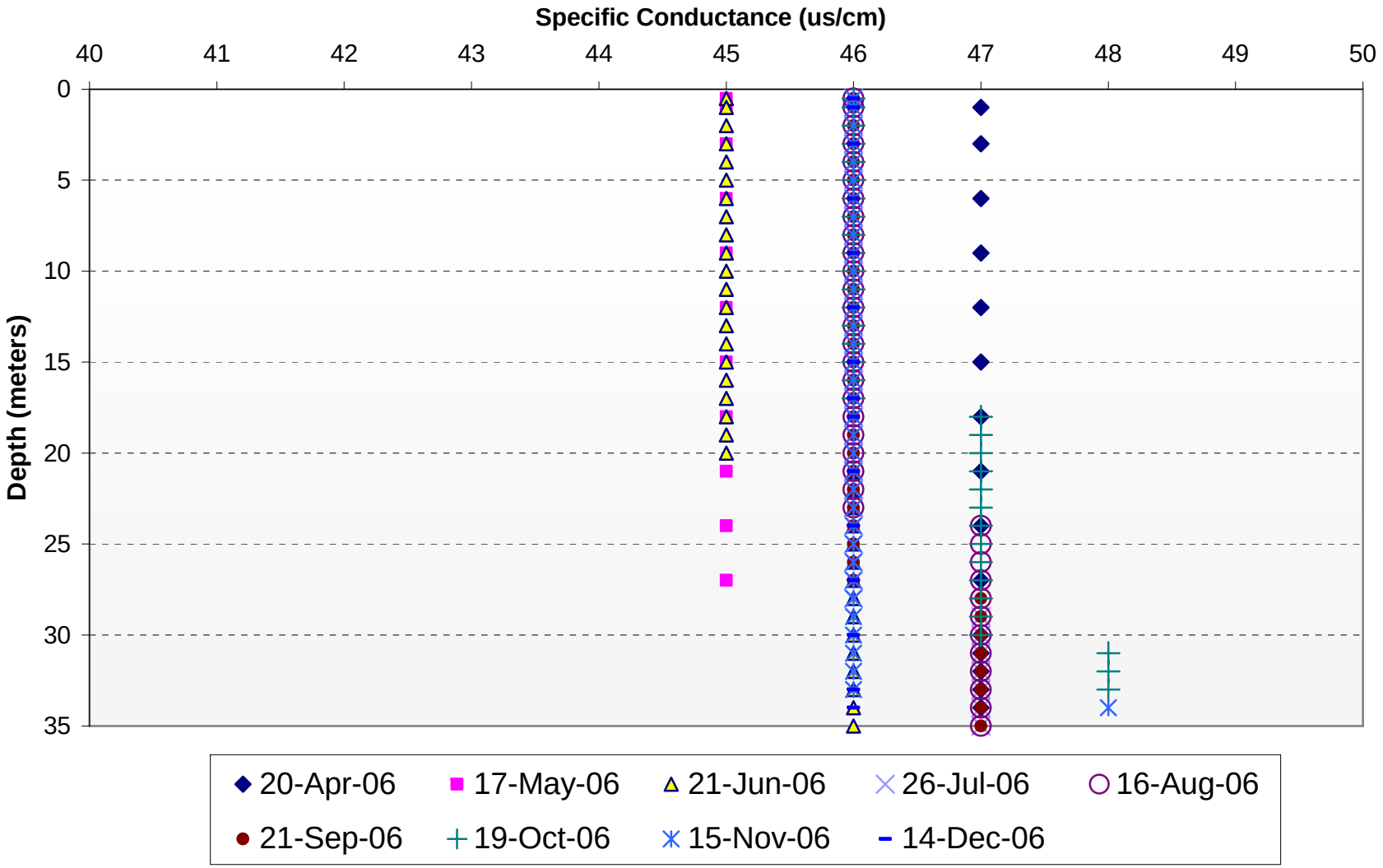
SHAFT 12 (Site 206) - CY 2006 Dissolved Oxygen Profiles

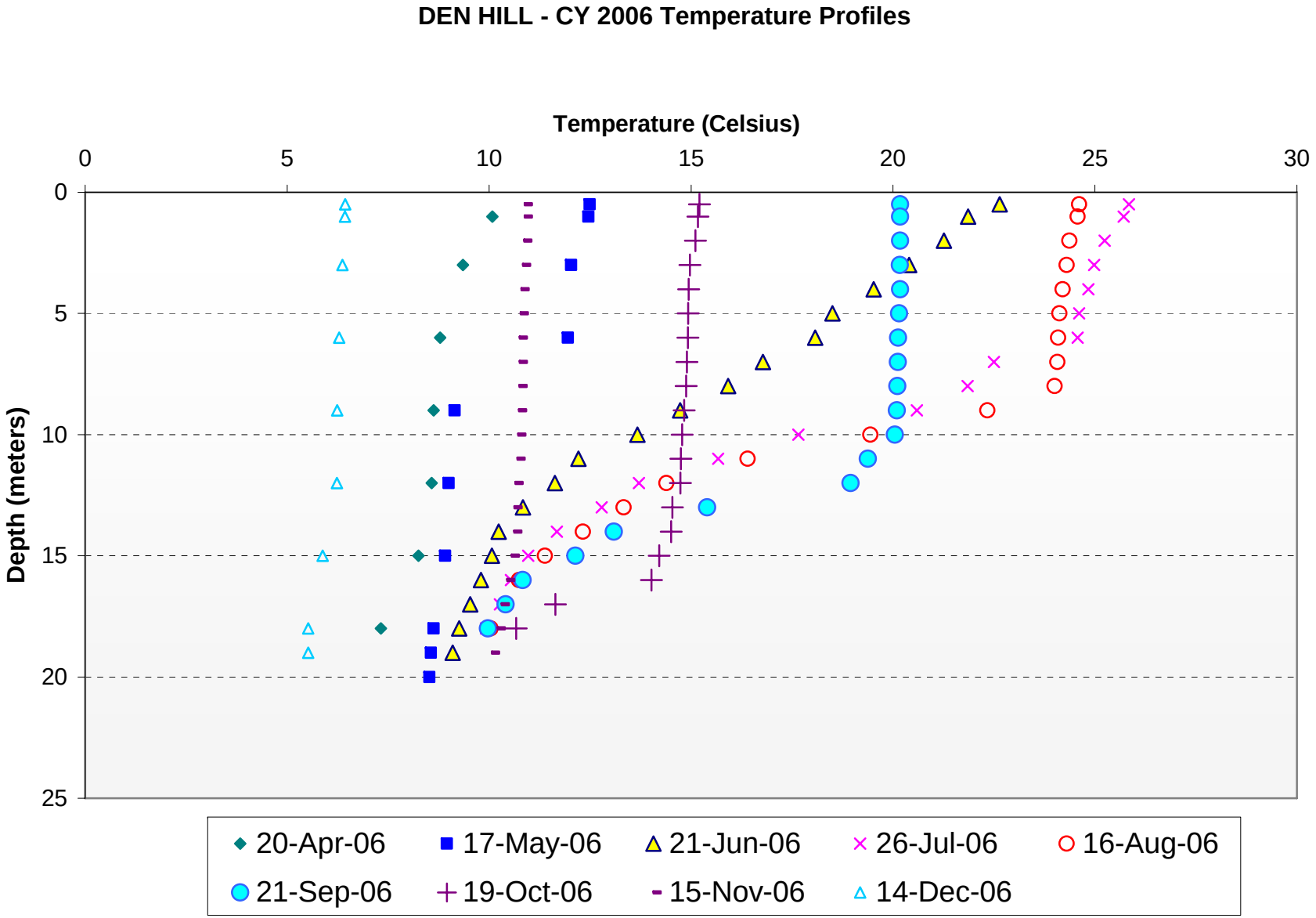


SHAFT 12 (Site 206) - CY 2006 pH Profiles

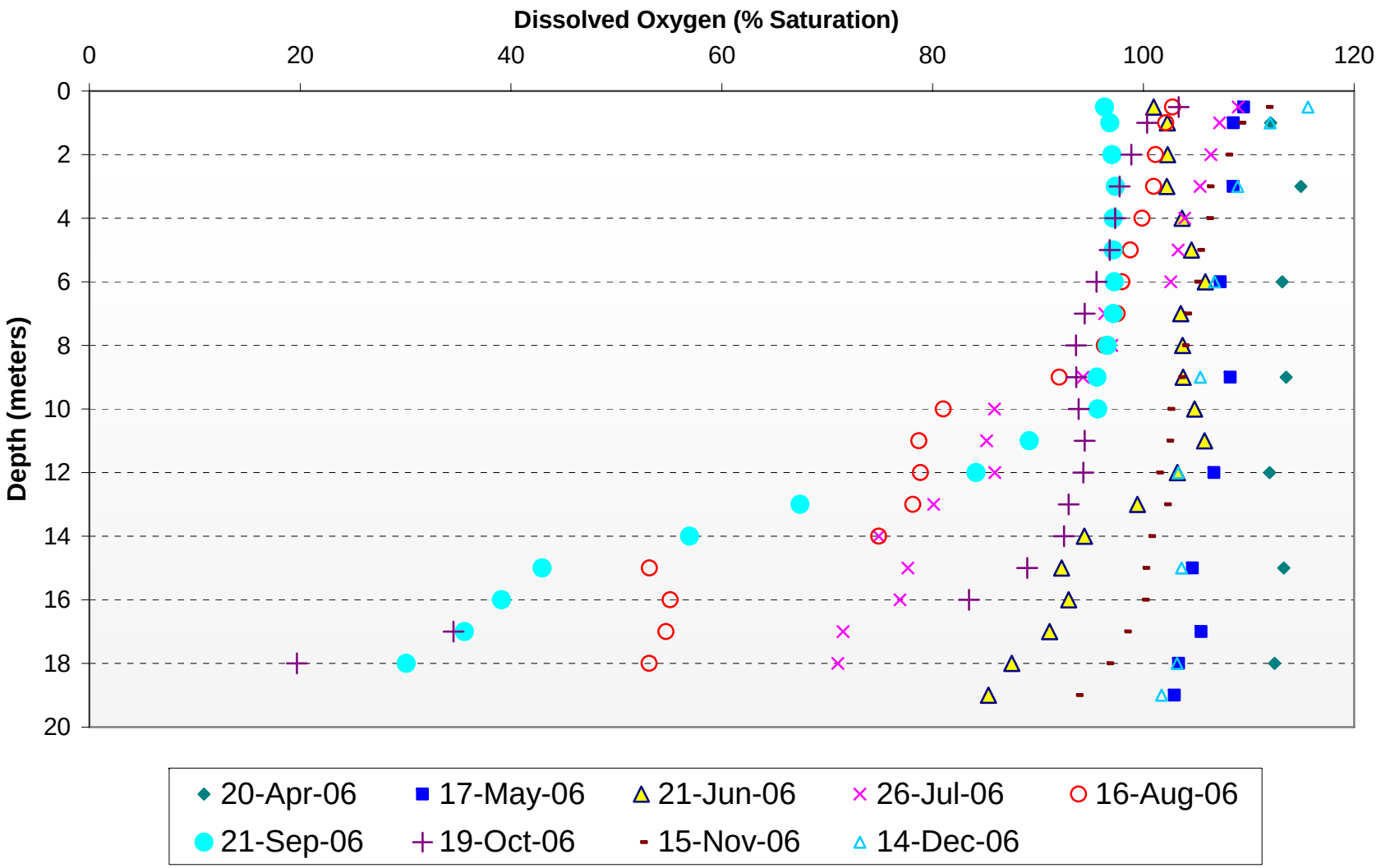


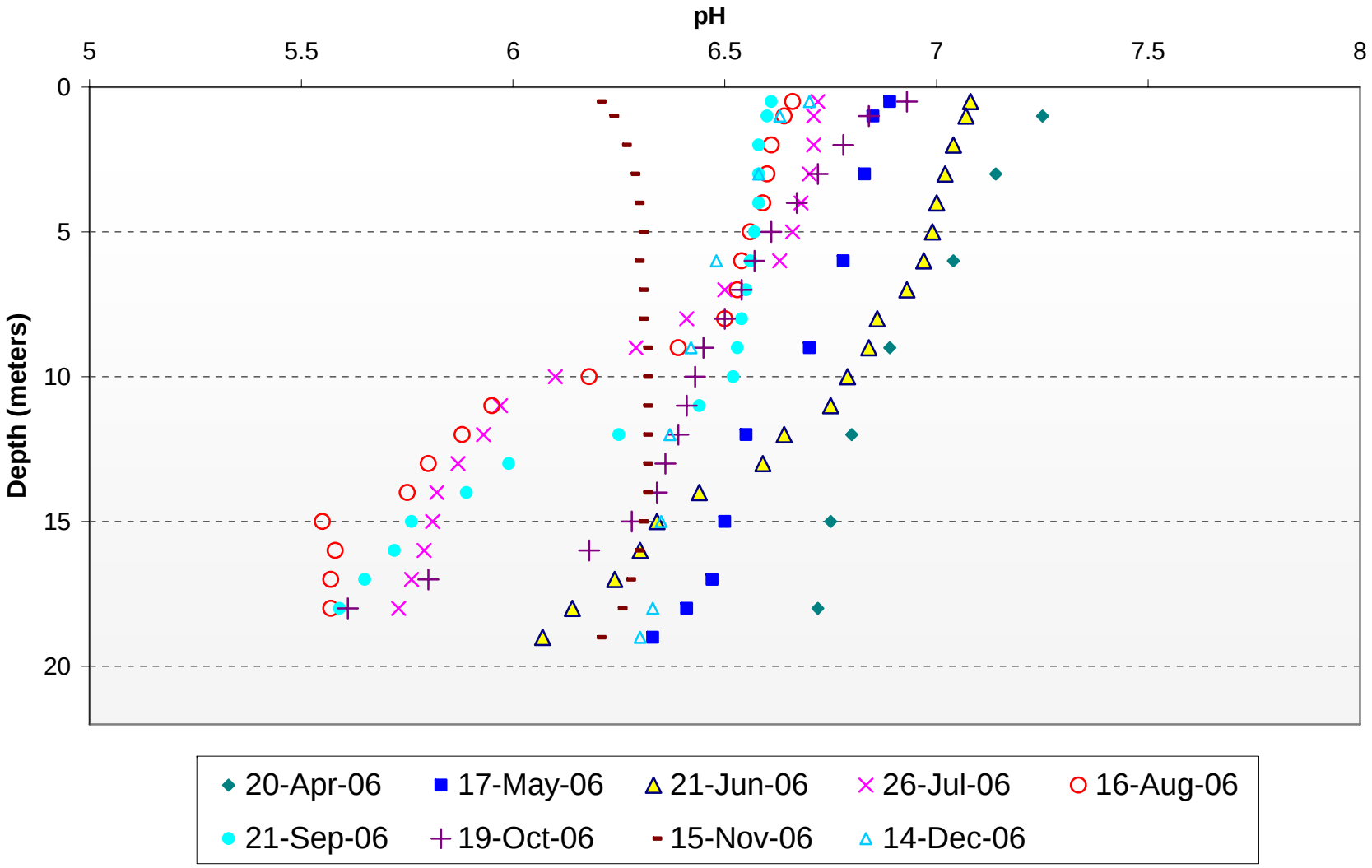
SHAFT 12 (Site 206) - CY 2006 Specific Conductance Profiles



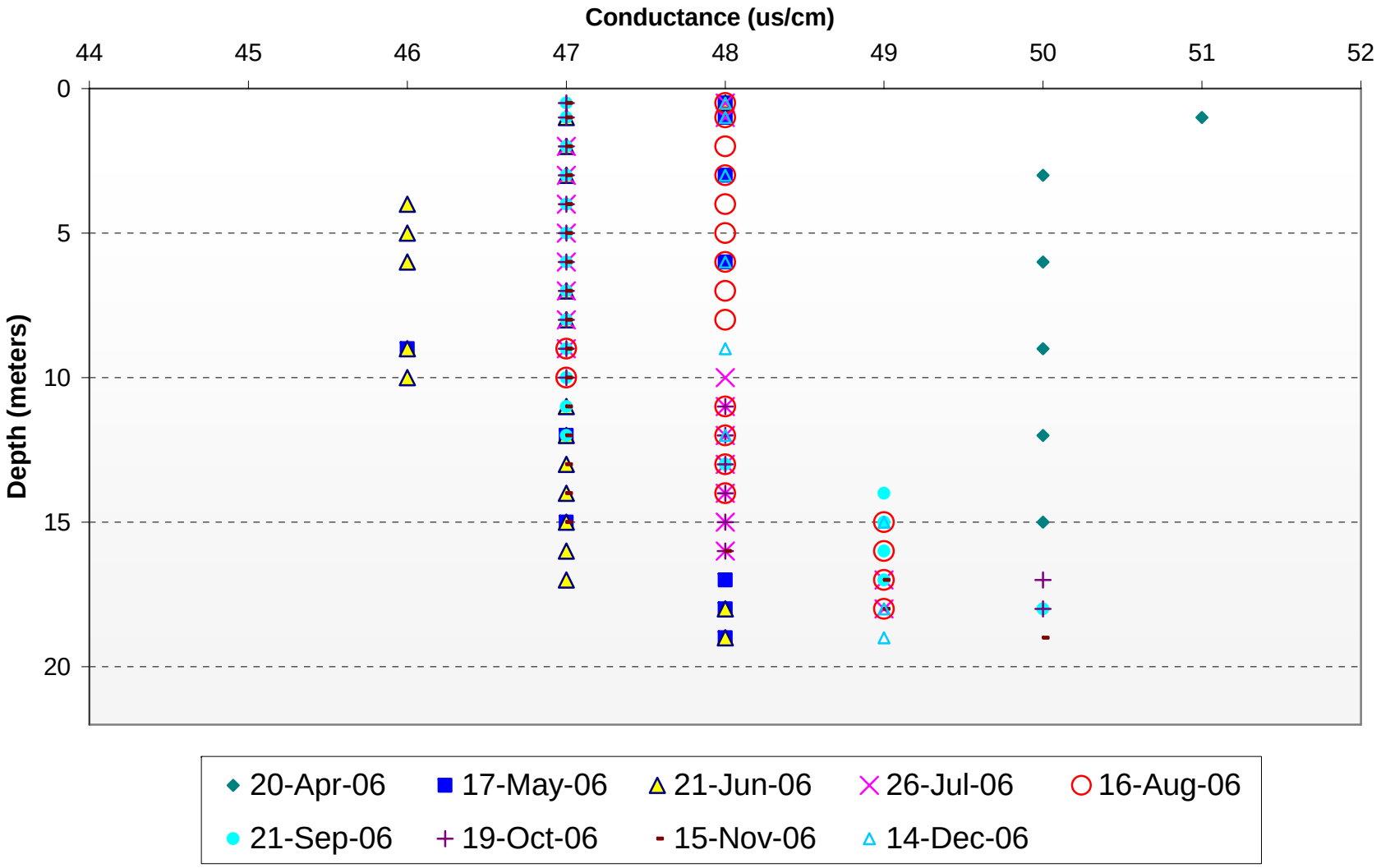

DEN HILL - CY 2006 Temperature Profiles
Temperature (Celsius)
0
5
10
15
20
25
30
Depth (meters)
0
5
10
15
20
25
20-Apr-06
17-May-06
21-Jun-06
26-Jul-06
16-Aug-06
21-Sep-06
19-Oct-06
15-Nov-06
14-Dec-06

DEN HILL - CY 2006 Dissolved Oxygen Profiles

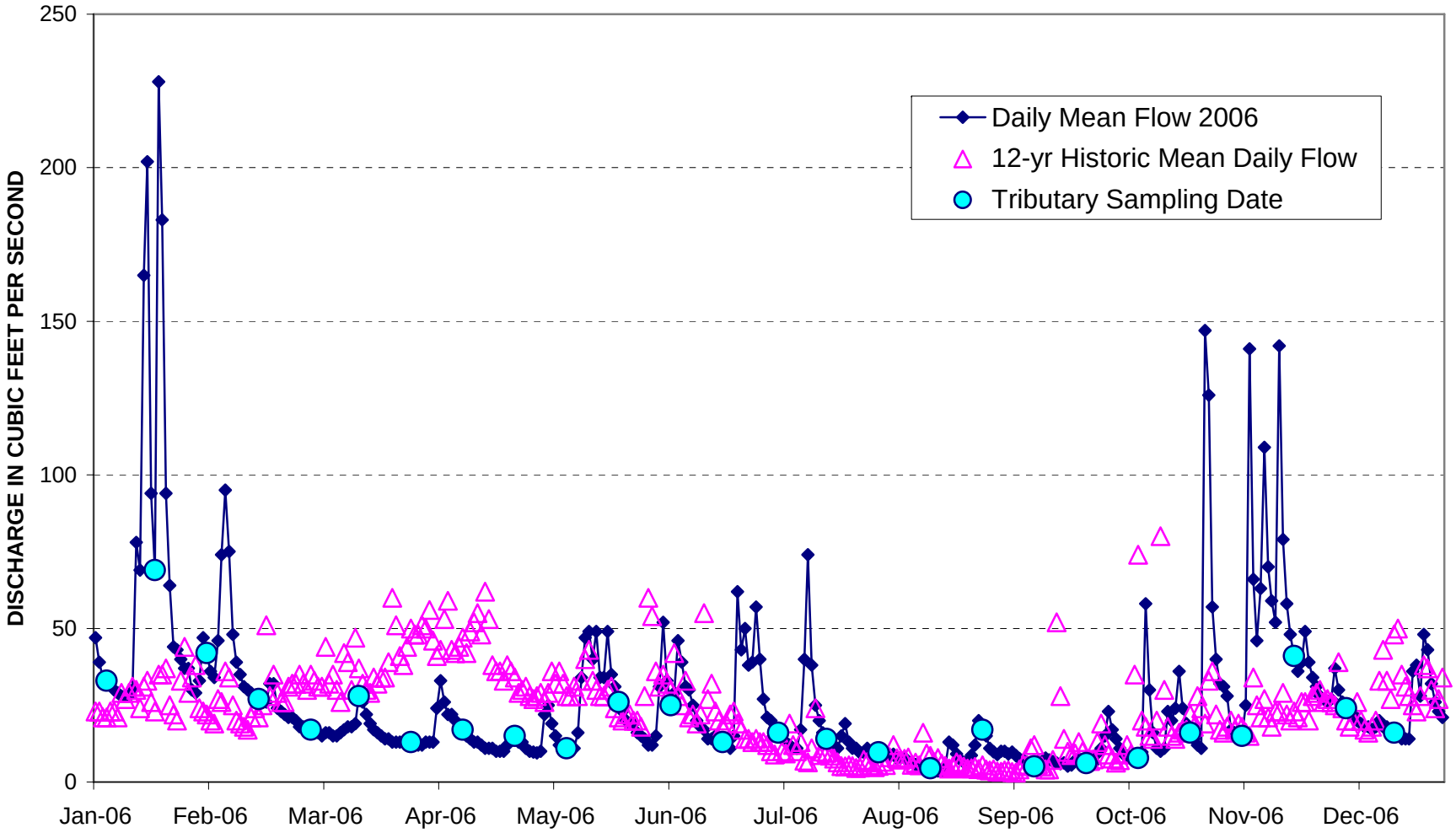



Den Hill - CY 2006 pH Profiles
pH
5
5.5
6
6.5
7
7.5
8
0
5
10
15
20
Depth (meters)
20-Apr-06
17-May-06
21-Jun-06
26-Jul-06
16-Aug-06
21-Sep-06
19-Oct-06
15-Nov-06
14-Dec-06

Den Hill - CY 2006 Specific Conductance Profiles



WEST BRANCH SWIFT RIVER NEAR SHUTESBURY
CALENDAR YEAR 2006



Source: U.S. Geological Survey website (provisional data accessed March 21, 2007).

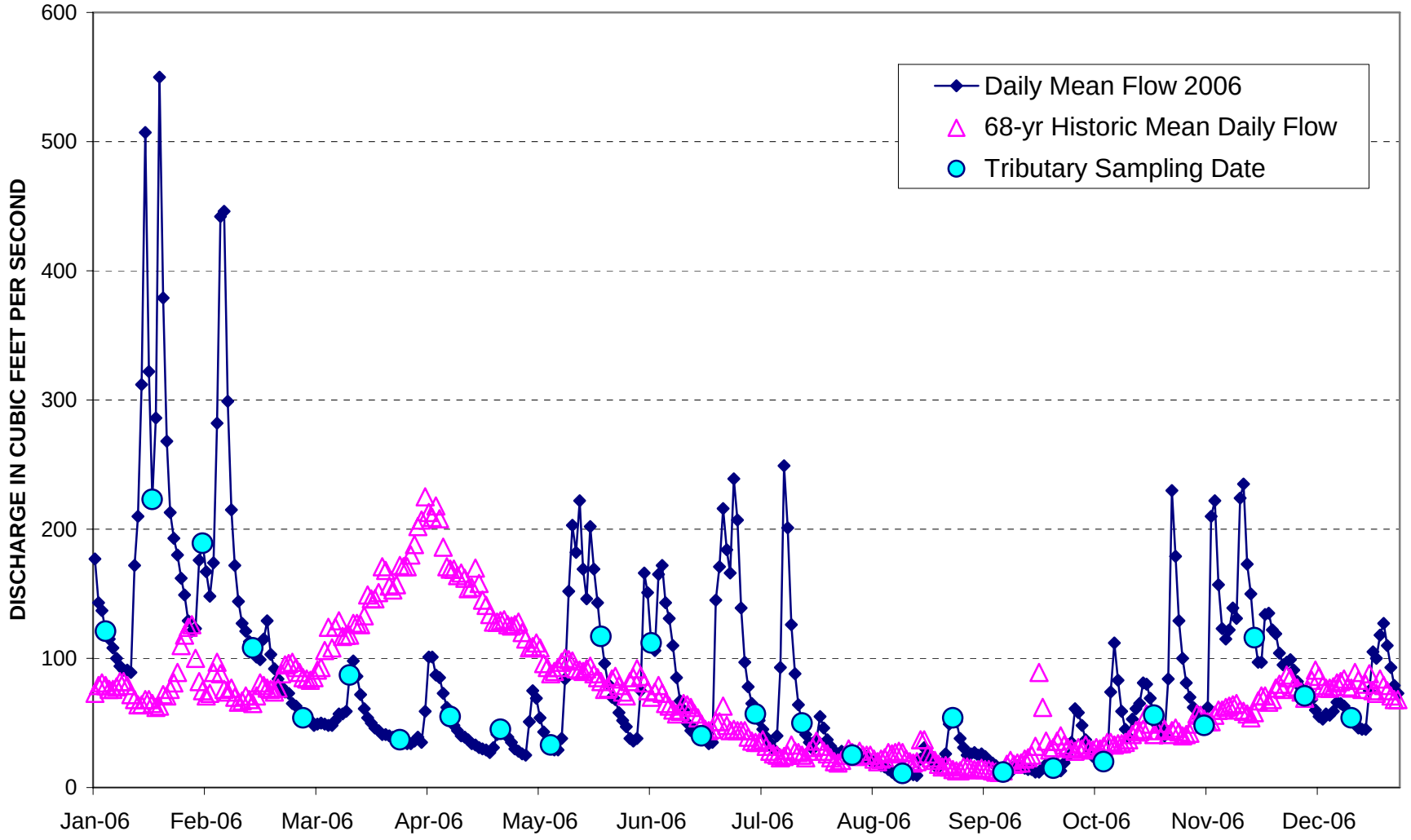
USGS 01174565: WEST BRANCH SWIFT RIVER NEAR SHUTESBURY, MA
JANUARY 1, 2006 - DECEMBER 31, 2006
Daily Mean Discharge, cubic feet per second

DATE	Jan 2006	Feb 2006	Mar 2006	Apr 2006	May 2006	Jun 2006	Jul 2006	Aug 2006	Sep 2006	Oct 2006	Nov 2006	Dec 2006
1	47 e	36 e	17 e	13 e	9.5 e	12 e	27 e	9.6 e	9.8 e	15 e	32	27
2	39 e	34 e	16 e	13 e	10 e	15 e	21 e	9.1 e	8.9 e	23 e	31	37
3	34 e	46 e	16 e	13 e	22 e	31 e	20 e	9.2 e	10 e	17 e	28	30
4	33 e	74 e	15 e	24 e	25 e	52 e	17 e	8.8 e	10 e	14 e	17 e	26
5	33 e	95 e	16 e	33 e	19 e	33 e	16 e	9 e	9.1 e	11 e	16 e	24
6	30 e	75 e	16 e	26 e	15 e	25 e	15 e	7.7 e	9.7 e	9.1 e	15 e	22
7	29 e	48 e	15 e	22 e	12 e	29 e	13 e	7.9 e	8.6 e	8.5 e	15 e	22
8	28 e	39 e	15 e	22 e	11 e	46 e	12 e	8 e	7.6 e	8 e	25 e	20
9	28 e	35 e	16 e	20 e	11 e	39 e	11 e	6.6 e	7.2 e	8 e	141	19
10	28 e	31 e	17 e	18 e	10 e	31 e	11 e	6.3 e	6.4 e	7.8 e	66	18
11	30	30 e	18 e	17 e	11 e	30 e	17 e	5.7 e	5.4 e	9.7 e	46	18
12	78	29 e	18 e	15 e	16 e	25 e	40 e	4.9 e	5.1 e	58	63	17
13	69	28 e	19 e	14 e	34 e	20 e	74 e	4.5 e	5 e	30	109	18
14	165	27 e	28 e	13 e	47 e	18 e	38 e	4.4 e	6.2 e	16	70	20
15	202	26 e	26 e	13 e	49 e	17 e	25 e	4.5 e	7.8 e	11	59	18
16	94	26 e	22 e	12 e	40 e	14 e	20 e	4.4 e	7.2 e	10	52	18
17	69	32 e	19 e	11 e	49 e	14 e	16 e	3.6 e	6.7 e	11	142	17
18	228	32 e	17 e	11 e	34 e	15 e	14 e	3.8 e	6.2 e	23	79	16
19	183	24 e	16 e	11 e	34 e	13 e	12 e	5 e	6 e	20	58	15
20	94 e	23 e	15 e	10 e	49 e	13 e	11 e	13 e	6.2 e	24	48	14
21	64 e	22 e	14 e	10 e	35 e	13 e	11 e	12 e	5.2 e	36	41	14
22	44 e	21 e	14 e	10 e	31 e	11 e	15 e	9.1 e	5.5 e	24	36	14
23	43 e	21 e	13 e	12 e	26 e	15 e	19 e	7.4 e	7.1 e	19	39	36
24	40 e	20 e	13 e	15 e	23 e	62 e	13 e	6.4 e	7.7 e	16	49	38
25	37 e	18 e	13 e	15 e	20 e	43 e	11 e	6.7 e	6.7 e	14	39	28
26	37 e	18 e	13 e	13 e	19 e	50 e	11 e	8.7 e	6.1 e	12	34	48
27	30 e	16 e	12 e	13 e	19 e	38 e	9.5 e	12 e	6 e	11	31	43
28	29 e	17 e	13 e	11 e	16 e	39 e	9.6 e	20 e	6.1 e	147	28	32
29	33 e		12 e	10 e	15 e	57 e	11 e	17 e	9.3 e	126	27	26
30	47 e		12 e	9.7 e	14 e	40 e	9.4 e	15 e	11 e	57	26	23
31	42 e		12 e		12 e		8.4 e	11 e		40		21
MAX	**228**	**95**	**28**	**33**	**49**	**62**	**74**	**20**	**11**	**147**	**142**	**48**
MIN	**28**	**16**	**12**	**9.7**	**9.5**	**11**	**8.4**	**3.6**	**5**	**7.8**	**15**	**14**
MEAN	**64**	**34**	**16**	**15**	**24**	**29**	**18**	**8.4**	**7.3**	**27**	**49**	**24**
DEPARTURE FROM NORM	32	9	-22	-27	-2	5	7	1	-3	2	24	-3
WY 95-06	**STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1995 - 2006**											
MEAN	32	24	38	42	25	24	11	7.2	10	24	25	27
MIN	2.6	6.9	16	15	13	3.7	2.0	1.7	1.0	1.8	1.7	4.1
MAX	64	41	60	79	44	53	26	29	53	111	49	75

Notes:
All data are provisional, subject to revision.
"e" denotes Estimated value.

Source: U.S. Geological Survey website (accessed March 21, 2007)

EAST BRANCH SWIFT RIVER NEAR HARDWICK, MA
CALENDAR YEAR 2006



Source: U.S. Geological Survey website (provisional data accessed March 21, 2007).

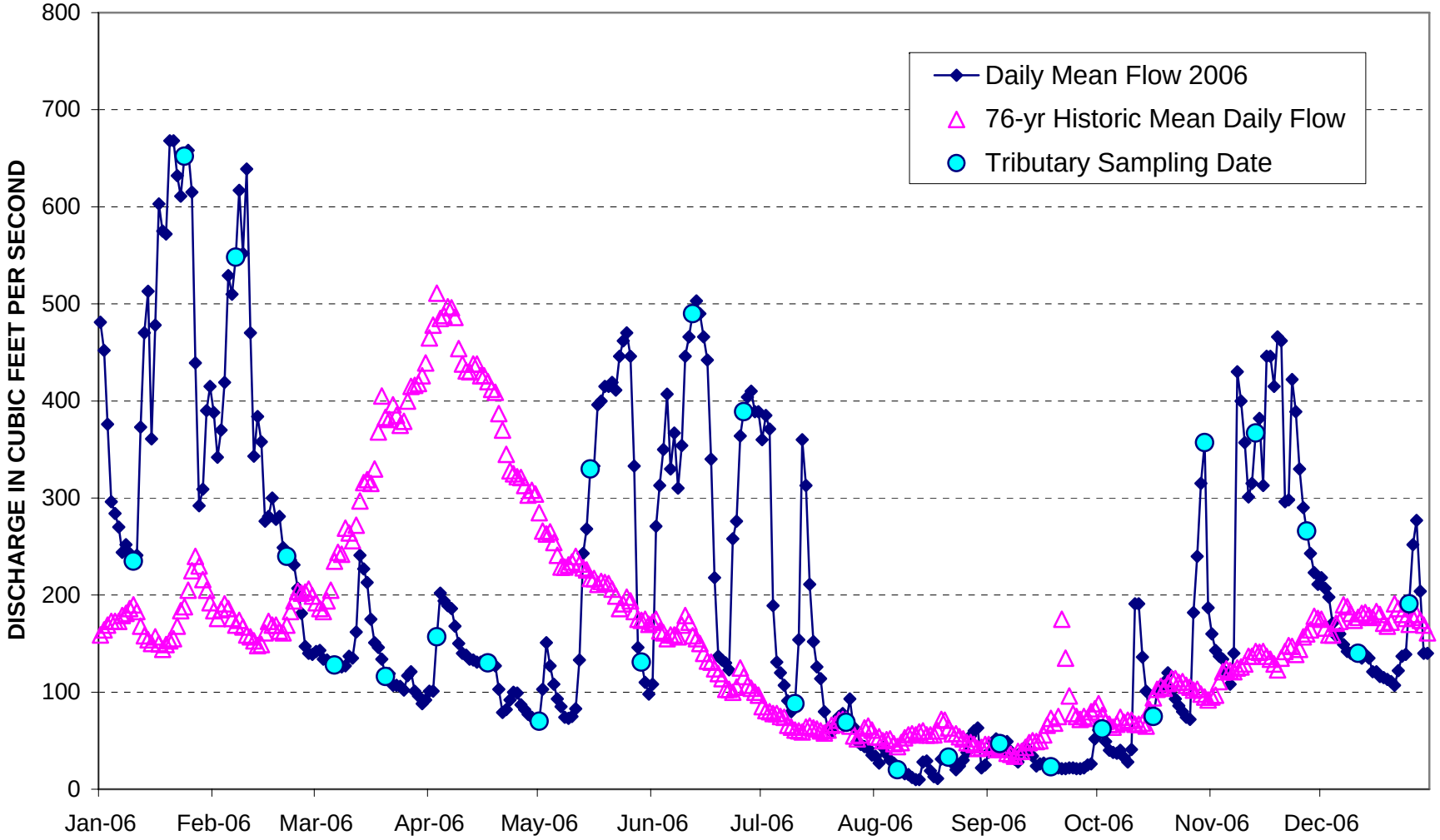
USGS 01174500: EAST BRANCH SWIFT RIVER NEAR HARDWICK, MA
JANUARY 1, 2006 - DECEMBER 31, 2006
Daily Mean Discharge, cubic feet per second

DATE	Jan 2006	Feb 2006	Mar 2006	Apr 2006	May 2006	Jun 2006	Jul 2006	Aug 2006	Sep 2006	Oct 2006	Nov 2006	Dec 2006
1	177	167	55	36	26	36	139	25	31	35	100	99
2	143	148	53	39	25	38	97	24	25	61	81	91
3	137	174	52	35	51	75	78	24	26	58	70	82
4	121	282	48	59	75	166	65	23	27	48	62	77
5	115	442	49	101	69	151	57	24	25	37	55	71
6	108	446	50	101	54	112	52	21	26	29	51	68
7	100	299	49	87	43	106	45	20	24	24	48	68
8	94	215	48	85	36	165	39	20	21	22	62	60
9	91	172	48	73	33	172	35	17	19	21	210	55
10	91	144	52	62	29	143	30	16	17	20	222	53
11	89	127	57	55	29	131	40	14	14	20	157	57
12	172	121	57	48	38	110	93	12	12	74	123	56
13	210	113	59	44	84	85	249	10	11	112	115	59
14	312	108	87	40	152	67	201	9.2	12	83	122	66
15	507	101	98	39	203	60	126	11	16	59	139	65
16	322	99	86	37	182	50	88	12	17	45	131	63
17	223	115	72	34	222	44	64	11	16	39	224	57
18	286	129	61	33	169	45	50	9.9	15	53	235	54
19	550	103	54	31	146	42	41	9.2	14	61	173	50
20	379	92	50	30	202	40	35	22	14	65	150	46
21	268	84	46	29	169	39	30	31	12	81	116	45
22	213	78	44	27	143	34	37	27 e	12	80	97	45
23	193	74	41	31	117	35	55	21	15	69	97	75
24	180	73	41	41	96	145	46	17	18	56	134	105
25	162	65	40	45	80	171	37	16	17	48	135	100
26	149	63	39	42	70	216	32	19	15	46	122	118
27	129	55	36	39	68	184	28	26	14	40	119	127
28	121	54	37	35	58	166	26	49	13	84	104	110
29	123		36	30	52	239	28	54	19	230	95	93
30	176		34	28	47	207	27	51	24	179	97	79
31	189		34		38		23	38		129		73
MAX	**550**	**446**	**98**	**101**	**222**	**239**	**249**	**54**	**31**	**230**	**235**	**127**
MIN	**89**	**54**	**34**	**27**	**25**	**34**	**23**	**9.2**	**11**	**20**	**48**	**45**
MEAN	**198**	**148**	**52**	**47**	**91**	**109**	**64**	**22**	**18**	**65**	**122**	**73**
DEPARTURE FROM NORM	115	67	-81	-113	-1	48	35	-1	-7	23	57	-6
WY 37-06	**STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1937 - 2006**											
MEAN	82	81	133	161	91	61	29	23	25	42	64	79
MIN	5.3	19	46	35	31	6.9	3.2	0	0	0.7	4.2	16
MAX	240	207	266	420	189	175	179	127	390	244	177	264

Notes:
All data are provisional, subject to revision.
"e" denotes Estimated value.

Source: U.S. Geological Survey website (accessed March 21, 2007)

WARE RIVER AT INTAKE WORKS NEAR BARRE, MA
CALENDAR YEAR 2006



Source: U.S. Geological Survey website (provisional data accessed March 22, 2007).

USGS 01172500: WARE RIVER NEAR BARRE, MA
JANUARY 1, 2006 - DECEMBER 31, 2006
Daily Mean Discharge, cubic feet per second

DATE	Jan 2006	Feb 2006	Mar 2006	Apr 2006	May 2006	Jun 2006	Jul 2006	Aug 2006	Sep 2006	Oct 2006	Nov 2006	Dec 2006
1	317	246	71	44	28	49	271	18	31	21	118	128
2	306	218	86	---	31	46	272	17 e	23	27	99	129
3	251	---	79	---	71	62	336	18 e	25	33	86	131
4	176	---	71	75	91	71	337	19	30	26	81	128
5	171	170 e	71	110	80	172	151	20	27 e	22	76	109
6	161	174 e	71	115	62	279	72	17	26	20	65	97
7	150	295	71	114	60	163	57	16	31 e	19	62	101
8	150	453	71	106	53	114	50	15	26	17	70	95
9	149	547	70	94	35	122	41	13	20	16	196	91
10	146	553	70	83	36	149	34	12	17	14	244	81
11	132	366	71	73	40	273	37	12	15	13	243	78
12	177	251	68	66	40	339	65	9.8	13	71	186	75
13	307	245	86	62	42	396	150	8.4	12	104	191	72
14	223	237	132	60	46	428	195	7.1	12	76	226	67
15	62	165	142	62	80	413	125	14	15	51	258	62
16	203	159	139	57	132	404	84	17	19	38	195	63
17	381	155	101	53	128	381	61	12	18	33	211	63
18	233	145	83	48	240	305	45	8.2	16	41	267	63
19	149	146	83	44	222	104 e	37	7.1	15	45	268	64
20	394	147	76	40 e	217	87	31	16	17	48	343	60
21	455	145	66	36 e	256	71	29	20	15	51	374	57
22	449	144	54	34	269	74	28	24	13	45	215	49
23	438	141	49	35	288	55	31	22	15	41	173	40
24	523	127	49	42	343	44	31	17	17	39	254	41
25	550	101	49	47	385	77	31	19	17	37	267	42
26	513	69	48	46	403	123	47	22	16	33	228	103
27	279	70	73	41	343	208	29	23	15	30	195	192
28	164	71	81	38	267	228	24	36	15	36	174	224
29	169		43	34	75	195	22	43	16	39	157	138
30	207		41	31	62	200	23	43	16	187	143	71
31	251		40		59		20	42		294		72
MAX	**550**	**553**	**142**	**115**	**403**	**428**	**337**	**43**	**31**	**294**	**374**	**224**
MIN	**62**	**69**	**40**	**31**	**28**	**44**	**20**	**7.1**	**12**	**13**	**62**	**40**
MEAN	**266**	**213**	**74**	**60**	**145**	**188**	**89**	**19**	**19**	**51**	**189**	**90**
DEPARTURE FROM NORM	85	35	-242	-348	-72	47	22	-34	-44	-42	49	-86
WY 28-06	**STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1928 - 2006**											
MEAN	180	178	317	408	217	140	67	53	63	93	140	176
MIN	17	38	118	125	74	18	9.0	4.9	6.1	7.9	14	29
MAX	499	488	1066	963	438	503	337	319	893	465	445	570

Notes:
All data are provisional, subject to revision.
"e" denotes Estimated value.

Source: U.S. Geological Survey website (accessed March 22, 2007)

APPENDIX C

Water Quality Data Tables

INDEX

Units of measure:
Temperature - Celsius
Dissolved Oxygen - mg/L
Specific Conductance - Microsiemens per centimeter
Coliform Bacteria - Number of colonies per 100 mL
E. Coli - Most Probable Number per 100 mL
Depth - Meters
Turbidity - Nephelometric turbidity units
Alkalinity - mg/L as CaCO3

QUABBIN LABORATORY RECORDS 2006

(211) WEST BR. OF SWIFT RIVER -- RT. 202

DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
01/04	0.21	6.28			18.38	130	0	40	2	*0*						
01/17	0.24	6.51			19.1	133	0	38	*0*	*0*						
01/31	0.22	6.28			20.5	151	2	37	*0*	*0*						
02/14	0.17	6.12			16.08	114	0	46	2	*0*						
02/28	0.22	6.39			15.3	107	0	52	*0*	*0*						
03/14	0.62	6.92			15.36	113	2	38	6	*0*						
03/28	0.28	6.86			13.59	111	6	45	*0*	*0*						
04/11	0.25	6.63			14.39	111	4	41	*0*	*0*						
04/25	0.40	6.72			13.68	116	7	41	3	*0*						
05/09	0.30	6.41			12.14	109	10	46	*0*	*0*						
05/23	0.23	6.21			11.34	100	9	36	4	10						
06/06	0.32	6.02			10.05	98	13	40	12	*0*						
06/20	0.42	6.93			8.99	96	18	50	84	109						
07/05	0.45	6.54			8.54	91	18	54	12	10						
07/18	0.50	6.75			8.3	92	19	53	30	10						
08/01	0.53	6.7			8.43	94	20	58	10	20						
08/15	0.66	6.74			8.32	89	18	80	*0*	52	0.02	0.106	0.106	*<0.005*	0.227	
08/29	0.47	6.23			9.09	93	16	40	30	31						
09/12	0.39	6.28			10.93	98	10	64	15	41						
09/26	0.43	6.4			10.28	94	10	56	11	*0*						
10/10	0.31	5.76			10.76	95	10	52	11	10						
10/24	0.32	6.72			10.99	93	7	39	13	10						
11/07	0.24	5.63			13.38	103	4	42	1	*0*						
11/21	0.32	5.95			13.92	109	4	35	5	20	0.01	0.01	0.00999	*<0.005*	0.12	
12/05	0.30	6.52			14.14	104	2	39	*0*	*0*						
12/18	0.26	7.0			12.1	97	5	42	*0*	*0*						
AVG.	0.3	6.4			12.6	105.5	8	46	10	12	0.015	0.058	0.058	*<0.005*	0.174	
MAX.	0.7	7.0			20.5	151	20	80	84	109	0.021	0.106	0.106	*<0.005*	0.227	
MIN.	0.2	5.6			8.3	89	0	35	<1	<10	0.010	0.010	0.010	*<0.005*	0.120	
MEDIAN	0.3	6.5			12.1	101	7	42	4	0	0.015	0.058	0.058	*<0.005*	0.174	

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

(211E) WEST BR. OF SWIFT RIVER (SIBLEY) -- COOLEYVILLE RD

DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
01/04	0.15	5.61	3.53	1.25	16.14	113	0	20	4	20	0.007	0.020	0.020	*<0.005*	0.184	0.069
01/17	0.2	5.62	2.99	0.89	16.59	116	0	19	2	*0*	0.007	0.018	0.018	*<0.005*	0.074	0.082
01/31	0.16	5.61	3.23	1.12	14.8	110	2	19	*0*	*0*	0.009	0.033	0.033	*<0.005*	0.078	0.066
02/14	0.21	5.67	3.03	1.2	15.91	112	0	21	*0*	*0*	0.005	0.026	0.026	*<0.005*	0.091	0.053
02/28	0.15	5.82	3.3	1.19	14.87	104	0	22	*0*	*0*	*<0.005*	0.031	0.031	*<0.005*	0.122	0.050
03/14	0.42	5.81	3.48	1.31	14.55	108	2	20	12	20	0.006	0.100	0.101	*<0.005*	0.199	0.078
03/28	0.25	6.12	3.86	1.58	13.49	109	6	19	*0*	*0*		0.020	0.020	*<0.005*		0.049
04/11	0.23	6.22	3.63	1.47	13.76	106	4	20	2	*0*	*<0.005*	0.017	0.017	*<0.005*	0.116	0.063
04/25	0.51	6.38	3.93	1.87	12.7	108	7	21	1	*0*	*<0.005*	0.009	0.009	*<0.005*	0.187	0.084
05/09	0.51	6.23	3.78	1.74	10.8	100	11	20	*0*	*0*	0.007	*<0.005*	*<0.005*	*<0.005*	0.150	0.082
05/23	0.17	5.28	4.13	1.7	10.88	96	9	19	2	*0*	0.006	*<0.005*	*<0.005*	*<0.005*	0.115	0.089
06/06	0.22	5.95	6.86	3.34	9.41	94	14	19	*0*	10	0.005	0.008	0.008	*<0.005*	0.121	0.106
06/20	0.29	5.85	5.45	2.97	8.07	88	19	20	30	10	0.009	0.034	0.035	*<0.005*	0.159	0.104
07/05	0.25	5.41	6.21	2.96	7.65	84	19	20	8	*0*	0.010	0.064	0.067	*<0.005*	0.197	0.134
07/18	0.3	5.78	8.03	4.31	7.4	84	21	19	*0*	20	0.015	0.049	0.051	*<0.005*	0.236	0.157
08/01	0.34	6.32	5.85	3	6.48	74	21	20	215	*0*	0.014	0.040	0.040	*<0.005*	0.225	0.162
08/15	0.34	6.09	3.55	1.63	7.66	84	19	19	14	*0*	0.013	0.045	0.045	*<0.005*	0.217	0.140
08/29	0.24	6.03	5.05	2.66	8.63	89	16	19	13	10	0.013	0.018	0.018	*<0.005*	0.196	0.152
09/12	0.26	5.34	7.09	3.82	9.16	85	11	20	*0*	*0*	0.012	0.021	0.021	*<0.005*	0.180	0.143
09/26	0.3	5.67	7.55	4.12	8.52	80	11	21	3	*0*	0.014	0.006	0.006	*<0.005*	0.157	0.140
10/10	0.24	5.08	2.79	1.29	9.73	86	10	20	3	*0*	0.010	*<0.005*	*<0.005*	*<0.005*	0.154	0.152
10/24	0.23	5.83	3.48	1.38	10.23	87	7	21	*0*	*0*	0.011	*<0.005*	*<0.005*	*<0.005*	0.158	0.150
11/07	0.18	5.31	4.5	1.95	12.8	98	4	21	*0*	*0*	0.008	0.006	0.007	*<0.005*	0.133	0.118
11/21	0.19	5.54	5.85	2.23	12.7	100	5	20	3	*0*	0.008	*<0.005*	*<0.005*	*<0.005*	0.141	0.122
12/05	0.17	5.57	4.07	1.47	13.3	99	2	21	*0*	*0*	0.008	*<0.005*	*<0.005*	*<0.005*	0.093	0.088
12/18	0.17	6.23	5.05	2.24	11.47	91	5	21	*0*	*0*	0.009	0.021	0.021	*<0.005*	0.098	0.073
AVG.	0.3	5.8	4.6	2.1	11.5	96.3	9	20	12	3	0.009	0.029	0.030	*<0.005*	0.151	0.104
MAX.	0.5	6.4	8.0	4.3	16.6	116	21	22	215	20	0.015	0.100	0.101	*<0.005*	0.236	0.162
MIN.	0.2	5.1	2.8	0.9	6.5	74	0	19	<1	<10	*<0.005*	*<0.005*	*<0.005*	*<0.005*	0.074	0.049
MEDIAN	0.2	5.8	4.0	1.7	11.2	97	7	20	2	0	0.009	0.021	0.021	*<0.005*	0.154	0.097

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

(211F) WEST BR. OF SWIFT RIVER (NEW BOSTON) -- COOLEYVILLE RD

DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
01/04	0.18	5.28	2.77	0.46	16.94	118	0	25	2	*0*	0.008	0.027	0.027	*<0.005*	0.118	0.088
01/17	0.2	5.19	2.53	0.36	16.71	116	0	26	*0*	*0*	0.008	0.016	0.016	*<0.005*	0.092	0.190
01/31	0.2	5.24	2.64	0.5	15.49	113	1	24	6	*0*	0.008	0.033	0.033	*<0.005*	0.086	0.093
02/14	0.16	5.44	2.44	0.63	16.18	114	0	26	*0*	20	*<0.005*	0.032	0.032	*<0.005*	0.096	0.069
02/28	0.2	5.86	3.04	1.05	15.13	106	0	28	*0*	*0*	*<0.005*	0.054	0.054	*<0.005*	0.128	0.064
03/14	0.7	5.67	3.04	0.87	15.16	109	1	25	*0*	10	0.009	0.118	0.119	*<0.005*	0.140	0.079
03/28	0.23	5.69	3.2	1.09	15.03	111	2	26	*0*	*0*		0.038	0.038	*<0.005*		0.066
04/11	0.22	6.06	2.99	0.89	14.58	112	4	26	*0*	*0*	*<0.005*	0.026	0.026	*<0.005*	0.123	0.080
04/25	0.39	5.74	3.17	1.07	12.88	110	7	29	3	*0*	*<0.005*	0.016	0.016	*<0.005*	0.199	0.107
05/09	0.23	6.28	3.04	1.03	12.33	110	10	27	1	*0*	*<0.005*	0.000	0.000	*<0.005*	0.217	0.092
05/23	0.19	4.81	3.32	0.98	11.27	99	9	24	*0*	*0*	*<0.005*	0.000	0.000	*<0.005*	0.144	0.115
06/06	0.23	5.71	5.7	2.05	9.91	97	13	25	*0*	*0*	0.007	0.005	0.005	*<0.005*	0.139	0.157
06/20	0.38	6.16	4.07	1.6	8.92	95	17	25	18	20	0.009	0.020	0.021	*<0.005*	0.174	0.143
07/05	0.47	5.32	5.35	1.99	8.15	88	18	25	8	10	0.013	0.034	0.037	*<0.005*	0.309	0.199
07/18	0.48	6.01	6.88	2.89	8.34	92	19	24	14	*0*	0.022	0.047	0.048	*<0.005*	0.240	0.210
08/01	0.6	6.21	5.16	2.41	8.29	92	19	24	13	20	0.016	0.061	0.063	*<0.005*	0.268	0.237
08/15	0.94	6.4	3.79	1.91	8.1	85	17	26	30	20	0.016	0.091	0.091	*<0.005*	0.212	0.157
08/29	0.58	5.94	3.43	1.18	8.79	90	16	24	205	41	0.017	0.021	0.021	*<0.005*	0.219	0.186
09/12	0.53	5.49	5.59	3.44	10.93	98	10	26	40	97	0.014	0.036	0.036	*<0.005*	0.170	0.134
09/26	0.65	5.84	6.17	2.67	10.28	94	10	26	54	20	0.016	0.022	0.022	*<0.005*	0.193	0.156
10/10	0.39	4.83	1.98	0.73	10.54	94	10	27	20	10	0.011	0.008	0.008	*<0.005*	0.156	0.176
10/24	0.32	5.43	2.12	0.25	10.77	91	7	27	4	*0*	0.012	0.000	0.000	*<0.005*	0.158	0.201
11/07	0.27	4.95	3.58	0.8	13	100	4	27	3	*0*	0.007	0.007	0.007	*<0.005*	0.126	0.126
11/21	0.24	4.95	4.31	0.93	13.29	104	4	25	3	10	0.010	*<0.005*	*<0.005*	*<0.005*	0.111	0.149
12/05	0.24	4.84	3.34	0.94	13.74	101	2	25	3	*0*	0.011	0.015	0.015	*<0.005*	0.133	0.126
12/18	0.25	5.52	4.15	1.2	11.9	95	5	26	*0*	*0*	0.013	0.037	0.037	*<0.005*	0.127	0.100
AVG.	0.4	5.6	3.8	1.3	12.2	101.3	8	26	16	11	0.012	0.031	0.031	*<0.005*	0.163	0.135
MAX.	0.9	6.4	6.9	3.4	16.9	118	19	29	205	97	0.022	0.118	0.119	*<0.005*	0.309	0.237
MIN.	0.2	4.8	2.0	0.3	8.1	85	0	24	<1	<10	*<0.005*	*<0.005*	*<0.005*	*<0.005*	0.086	0.064
MEDIAN	0.3	5.6	3.3	1.0	12.1	100	7	26	3	0	0.011	0.026	0.026	*<0.005*	0.144	0.130

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

(211G) WEST BR. OF SWIFT RIVER (COOLEYVILLE) -- COOLEY. RD. EXT.

DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
01/04	0.32	6.52	10.8	8.65	16.24	120	2	93	1	*0*	0.014	0.039	0.039	*<0.005*	0.118	0.035
01/17	0.42	6.72	9.72	7.61	15.53	113	2	93	4	20	0.019	0.035	0.035	*<0.005*	0.080	0.036
01/31	0.68	6.86	9.56	7.61	15.2	118	4	118	8	*0*	0.022	0.051	0.051	*<0.005*	0.102	0.041
02/14	0.31	6.64	10.1	8.15	16.04	117	2	105	8	20	0.008	0.042	0.042	*<0.005*	0.068	0.027
02/28	0.41	6.77	11	8.97	15.56	109	0	123	2	20	0.006	0.057	0.057	*<0.005*	0.100	0.024
03/14	1.2	6.79	9.56	7.59	13.74	109	5	128	50	98	0.016	0.134	0.136	*<0.005*	0.146	0.066
03/28	0.3	7.2	11.5	9.47	12.95	108	7	132	*0*	*0*		0.045	0.045	*<0.005*		0.029
04/11	0.38	6.94	11.2	9.12	14.26	111	4	134	11	20	*<0.005*	0.048	0.048	*<0.005*	0.071	0.035
04/25	0.83	7.06	11.5	9.49	12.97	110	7	138	4	10	*<0.005*	0.046	0.046	*<0.005*	0.132	0.052
05/09	0.45	6.98	12.6	10.7	12.39	110	9	126	1	*0*	0.009	0.026	0.026	*<0.005*	0.146	
05/23	0.4	6.43	11.1	8.9	11.47	99	8	93	10	10	0.012	0.019	0.019	*<0.005*	0.129	0.043
06/06	0.41	7.07	12.1	9.63	10.5	98	11	121	4	41	0.012	0.030	0.030	*<0.005*	0.099	0.062
06/20	0.63	7.32	13.3	11	9.35	95	15	121	16	84	0.016	0.087	0.088	*<0.005*		0.086
07/05	0.53	6.79	13.9	11.6	9.28	94	15	124	16	52	0.017	0.034	0.036	*<0.005*	0.167	0.077
07/18	0.91	7.09	15.6	12.9	8.89	95	18	133	6	97	0.022	0.064	0.067	*<0.005*	0.145	0.093
08/01	0.83	7.21	15.8	13.4	8.76	95	18	139	205	*0*	0.019	0.093	0.093	*<0.005*	0.118	0.088
08/15	0.91	7.18	15.3	13.4	8.87	93	17	151	1	109	0.022	0.126	0.127	*<0.005*	0.131	0.088
08/29	0.63	6.67	15.4	13.5	9.56	97	15	158	140	10	0.019	0.092	0.092	*<0.005*	0.109	0.078
09/12	0.52	6.45	15.8	13.7	11.5	101	9	182	7	20	0.014	0.078	0.078	*<0.005*	0.084	0.050
09/26	0.52	6.57	16.6	14.3	10.52	95	10	184	15	10	0.017	0.054	0.054	*<0.005*	0.072	0.055
10/10	0.39	6.24	14.8	13.3	10.67	95	10	204	3	10	0.012	0.034	0.034	*<0.005*	0.069	0.054
10/24	0.44	6.74	12.7	11	10.89	92	7	185	*0*	*0*	0.013	0.049	0.049	*<0.005*	0.090	0.069
11/07	0.36	5.97	12.8	10.8	12.72	102	6	130	*0*	*0*	0.011	0.057	0.057	*<0.005*	0.095	0.049
11/21	0.65	6.58	12.4	9.71	13.24	106	5	94	*0*	*0*	0.015	0.031	0.032	*<0.005*	0.073	0.052
12/05	0.52	6.37	12.6	10.4	13.55	102	3	113	*0*	*0*	0.013	0.056	0.056	*<0.005*	0.078	0.045
12/18	0.51	6.8	13.8	11.2	11.4	95	6	121	2	*0*	0.016	0.063	0.063	*<0.005*	0.075	0.041
AVG.	0.6	6.8	12.8	10.6	12.2	103.0	8	132	20	24	0.015	0.057	0.058	*<0.005*	0.104	0.055
MAX.	1.2	7.3	16.6	14.3	16.2	120	18	204	205	109	0.022	0.134	0.136	*<0.005*	0.167	0.093
MIN.	0.3	6.0	9.6	7.6	8.8	92	0	93	*<1*	*<10*	0.006	0.019	0.019	*<0.005*	0.068	0.024
MEDIAN	0.5	6.8	12.6	10.6	11.9	101	7	127	4	10	0.015	0.050	0.050	*<0.005*	0.100	0.052

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

(213) MIDDLE BR. OF SWIFT RIVER @ GATE #30

DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
01/04	0.35	6.2			13.97	98	0	69	5	30						
01/17	0.36	6.58			14.66	103	0	69	2	10						
01/31	0.34	6.57			13.73	100	1	67	14	*0*						
02/14	0.29	6.09			13.62	96	0	86	2	10						
02/28	0.4	6.5			13.75	97	0	93	2	*0*						
03/14	0.83	6.43			12.81	96	2	66	10	41						
03/28	0.56	6.28			12.01	97	6	83	*0*	20						
04/11	0.63	6.36			10.74	92	8	80	*0*	*0*						
04/25	0.91	6.18			10.29	93	10	72	42	52						
05/09	1.16	6.39			8.53	85	15	78	20	30						
05/23	0.54	5.98			8.93	84	11	69	24	20						
06/06	0.83	5.97			6.85	71	16	74	32	52						
06/20	1.38	6.13			5.22	61	22	85	52	41						
07/05	1.41	5.7			4.45	52	22	90	21	74						
07/18	1.27	5.92			4.17	51	24	88	32	31						
08/01	1.37	6.12			4.02	48	23	88	116	41						
08/15	0.99	6.24			5.76	63	19	113	1	41	0.023	0.017	0.018	*<0.005*	0.336	
08/29	1.26	5.85			5.26	55	17	79	3	98						
09/12	0.81	5.31			6.73	67	14	83	16	10						
09/26	0.98	5.63			6.06	60	14	91	56	85						
10/10	0.83	5.15			6.59	61	11	79	9	*0*						
10/24	0.93	5.58			7.95	69	8	63	23	10						
11/07	0.67	5.78			10.78	83	4	63	5	*0*						
11/21	0.7	5.7			9.9	78	5	59	8	31	0.013	0.029	0.030	*<0.005*	0.194	
12/05	0.78	5.55			11.12	83	3	67	7	10						
12/18	0.7	6.4			10.5	80	3	74	*0*	*0*						
AVG.	0.8	6.0			9.2	77.8	10	78	19	28	0.018	0.023	0.024	*<0.005*	0.265	
MAX.	1.4	6.6			14.7	102.5	24	113	116	98	0.023	0.029	0.030	*<0.005*	0.336	
MIN.	0.3	5.2			4.0	48.2	0	59	<1	<10	0.013	0.017	0.018	*<0.005*	0.194	
MEDIAN	0.8	6.1			9.4	81.4	9	79	10	25	0.018	0.023	0.024	*<0.005*	0.265	

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

(213A) MIDDLE BRANCH SWIFT @ FAY ROAD

SORT	DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
16167	01/04	0.38	6.38	7.82	5.68	14.9	104	0.14	73	27	75	0.013	0.195	0.195	*<0.005*	0.165	0.082
16168	01/17	0.37	6.7	6.9	5.14	14.95	104	0.20	80	2	10	0.015	0.149	0.149	*<0.005*	0.133	0.080
16169	01/31	0.42	6.61	5.09	3.15	14.67	108	1.84	54	18	*0*	0.010	0.108	0.108	*<0.005*	0.119	0.090
16170	02/14	0.3	6.44	5.68	3.95	15.14	107	0.22	57	*0*	10	0.009	0.140	0.140	*<0.005*	0.120	0.069
16171	02/28	0.44	6.55	8.41	6.49	13.87	97	0.11	67	*0*	*0*	0.006	0.279	0.279	*<0.005*	0.183	0.064
16172	03/14	1.47	6.73	7	5.05	13.54	103	3.07	51	200	473	0.019	0.304	0.306	*<0.005*	0.348	0.120
16173	03/28	0.71	6.55	7.19	5.36	13.34	102	3.35	69	4	10		0.164	0.166	*<0.005*		0.073
16174	04/11	0.78	6.88	8.04	6.17	12.2	96	4.94	73	*0*	*0*	0.011	0.119	0.119	*<0.005*	0.162	0.093
16175	04/25	0.9	6.4	7.85	5.9	11.14	100	9.44	60	58	75	0.031	0.068	0.068	*<0.005*	0.268	0.158
16176	05/09	1.45	6.67	10.8	8.9	8.71	83	12.48	65	46	41	0.015	0.031	0.031	*<0.005*	0.266	0.154
16177	05/23	0.48	6.02	8.6	6.18	9.41	87	10.53	76	18	20	0.007	0.015	0.015	*<0.005*	0.178	0.127
16178	06/06		6.35			7.18	73	15.29	74			0.010	0.032	0.032	*<0.005*	0.203	0.176
16179	06/20	1.82	6.57	14.2	11.5	4.96	56	20.10	67	260	399	0.026	0.063	0.065	*<0.005*		
16180	07/05	2.08	6.26	14.1	11.4	4.24	48	20.37	91	60	75	0.031	0.049	0.053	*<0.005*	0.303	0.245
16181	07/18	1.91	6.26	15.6	12.4	4.33	51	22.53	88	1440	1660	0.039	0.050	0.053	*<0.005*	0.318	0.261
16182	07/20									80							
16183	08/01	1.76	6.45	15.2	12.6	4	47	21.77	93	130	657	0.027	0.055	0.056	*<0.005*	0.305	0.217
16184	08/15	2.97	6.43	15.3	13.3	4.24	47	19.41	98	*0*	1010	0.029	0.047	0.048	*<0.005*	0.315	0.163
16185	08/29	1.56	6.36	10	8.02	6.37	66	16.19	66	1	448	0.021	0.043	0.043	*<0.005*	0.272	0.235
16186	09/12	3.25	5.8	15.6	12.7	6.57	62	11.97	86	120	158	0.027	0.020	0.020	*<0.005*	0.292	0.192
16187	09/26	2.41	5.86	14.8	11.6	6.06	58	12.38	77	44	63	0.027	0.011	0.011	*<0.005*	0.271	0.219
	10/10	1.97	5.31	12.5	10.8	5.62	51	11.10	78	20	31	0.021	0.012	0.012	*<0.005*	0.212	0.205
	10/24	1.25	6.33	9.55	7.68	8.02	69	7.23	57	8	*0*	0.017	0.031	0.032	*<0.005*	0.216	0.219
	11/07	1.48	5.94	9.02	6.33	10.1	79	4.72	55	11	20	0.043	0.075	0.076	*<0.005*	0.414	0.152
	11/21	0.6	6.04	7.15	3.89	11.59	89	3.76	40	3	10	0.017	0.057	0.057	*<0.005*	0.221	0.164
16188	12/05	0.7	5.92	8.73	6.49	12.05	88	1.51	58	4	*0*	0.013	0.134	0.134	*<0.005*	0.156	0.135
	12/18	1.0	6.4	9.8	7.4	10.6	84	4.20	60	8	*0*	0.018	0.179	0.179	*<0.005*	0.225	0.113
	AVG.	1.30	6.32	10.2	7.9	9.53	79	9.19	70	99	210	0.020	0.093	0.094	*<0.005*	0.236	0.152
	MAX.	3.25	6.88	15.6	13.3	15.14	108	22.53	98	1440	1660	0.043	0.304	0.306	*<0.005*	0.414	0.261
	MIN.	0.30	5.31	5.1	3.2	4.00	47	0.11	40	*<1*	*<10*	0.006	0.011	0.011	*<0.005*	0.119	0.064
	MEDIAN	1.25	6.39	9.0	6.5	9.76	83	8.34	68	18	31	0.018	0.060	0.061	*<0.005*	0.223	0.154

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

(213B) MIDDLE BRANCH SWIFT @ ELM STREET

SORT	DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
16308	01/04	0.3	6.64	5.04	2.76	17.24	120	0	34	*0*	*0*	0.010	0.081	0.081	*<0.005*	0.182	0.094
16309	01/17	0.33	6.65	4.16	2.44	16.39	114	0	34	2	*0*	0.010	0.061	0.061	*<0.005*	0.100	0.106
16310	01/31	0.3	6.56	4.16	2.39	15.44	113.2	2	34	*0*	*0*	0.009	0.077	0.077	*<0.005*	0.129	0.094
16311	02/14	0.3	6.56	4.41	2.62	16.22	114	0	38	*0*	*0*	*<0.005*	0.095	0.095	*<0.005*	0.113	0.074
16312	02/28	0.33	6.68	5.76	3.85	15.55	109	0	42	*0*	*0*	*<0.005*	0.126	0.126	*<0.005*	0.143	0.066
16313	03/14	1.66	6.75	4.5	2.61	15.18	112	2	36	18	20	0.016	0.196	0.198	*<0.005*	0.328	0.127
16314	03/28	0.34	6.47	5.52	3.63	14.56	110	3	41	*0*	*0*		0.109	0.109	*<0.005*		0.071
16315	04/11	0.32	6.94	5.42	3.42	14.3	112	5	42	*0*	*0*	*<0.005*	0.079	0.079	*<0.005*	0.104	0.091
16316	04/25	0.46	6.96	5.47	3.28	12.7	110	8	43	9	10	*<0.005*	0.053	0.053	*<0.005*	0.173	0.138
16317	05/09	0.41	6.96	6.41	4.41	12.21	111	10	45	48	41	0.010	0.048	0.048	*<0.005*	0.204	0.118
16318	05/23	0.36	6.34	6.05	3.55	11.03	98	9	38	6	*0*	*<0.005*	0.019	0.019	*<0.005*	0.131	0.132
16319	06/06	0.42	6.65	7.47	4.48	9.77	96	13	40	46	20	0.008	0.044	0.044	*<0.005*	0.183	0.179
16320	06/20	0.6	7.02	8.26	5.44	8.62	93	18	44	50	20	0.014	0.103	0.104	*<0.005*		0.192
16321	07/05	0.63	6.68	9.44	6.28	8.14	89	19	45	23	*0*	0.015	0.118	0.121	*<0.005*	0.190	0.225
16322	07/18	0.59	6.98	10.5	6.93	8.11	91	20	46	14	20	0.021	0.148	0.150	*<0.005*	0.218	0.221
	08/01	0.57	7.06	10.4	7.65	8.09	90	20	49	2	63	0.019	0.156	0.157	*<0.005*	0.215	0.212
	08/15	0.45	7.02	10	8.25	8.55	90	17	53	4	51	0.016	0.203	0.203	*<0.005*	0.163	0.120
	08/29	0.68	6.59	6.42	4.35	9.14	93	16	44	4	52	0.016	0.065	0.066	*<0.005*	0.213	0.231
16323	09/12	0.38	6.29	11.2	8.17	10.92	97	10	51	1	20	0.013	0.124	0.124	*<0.005*	0.130	0.136
16324	09/26	0.52	6.57	11.2	7.73	9.91	93	11	47	3	10	0.017	0.035	0.035	*<0.005*	0.171	0.196
	10/10	0.41	6.13	7.61	6	10.35	93	10	49	*0*	*0*	0.013	0.019	0.019	*<0.005*	0.150	0.184
	10/24	0.42	6.7	5.92	4.08	10.66	90	7	43	3	*0*	0.014	0.033	0.033	*<0.005*	0.194	0.198
	11/07	0.38	6.02	6.49	3.77	12.68	99	5	40	1	10	0.010	0.047	0.049	*<0.005*	0.203	0.142
	11/21	0.42	6.21	6.87	3.66	13.41	104	4	36	*0*	*0*	0.012	0.044	0.045	*<0.005*	0.108	0.157
	12/05	0.43	6.18	6	3.71	13.81	100	1	38	4	*0*	0.010	0.068	0.068	*<0.005*	0.127	0.129
	12/18	0.45	6.49	6.99	4.33	11.48	93	5	39	4	*0*	0.013	0.088	0.088	*<0.005*	0.122	0.112
	AVG.	0.5	6.6	7.0	4.6	12.1	101	8	42	9	13	0.013	0.086	0.087	*<0.005*	0.166	0.144
	MAX.	1.7	7.1	11.2	8.3	17.2	120	20	53	50	63	0.021	0.203	0.203	*<0.005*	0.328	0.231
	MIN.	0.3	6.0	4.2	2.4	8.1	89	0	34	*<1*	*<10*	*<0.005*	0.019	0.019	*<0.005*	0.100	0.066
	MEDIAN	0.4	6.6	6.4	4.0	11.8	98	8	42	3	0	0.013	0.078	0.078	*<0.005*	0.167	0.134

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

(216) EAST BR. OF SWIFT RIVER @ RT. 32A

SORT	DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
16090	01/04	0.38	6.32			15.85	110	0	64	2	*0*						
16091	01/17	0.44	6.62			16.11	112	0	61	10	*0*						
16092	01/31	0.37	6.79			15.54	113	1	66	20	41						
16093	02/14	0.41	6.23			16.2	113	0	69	*0*	*0*						
16094	02/28	0.44	6.72			15.4	108	0	82	*0*	31						
16095	03/14	0.82	6.75			14.36	109	3	61	6	10						
16096	03/28	0.44	6.53			14.19	113	5	67	*0*	*0*						
16097	04/11	0.52	6.6			13	110	8	67	*0*	*0*						
16098	04/25	0.85	6.6			11.86	110	11	74	1	*0*						
16099	05/09	0.63	6.39			10.9	105	13	69	4	*0*						
16100	05/23	0.72	6.25			10.19	97	12	59	6	10						
16101	06/06	1.19	6.69			9.12	95	16	61	18	63						
16102	06/20	0.97	6.96			7.93	93	22	71	24	31						
16103	07/05	0.95	6.77			7.65	88	21	67	58	63						
16104	07/18	0.78	6.96			7.58	92	24	66	10	10						
16105	08/01	0.71	7.28			7.33	89	24	76	2	52						
16106	08/15	0.7	7.03			8.11	90	19	76	43	52	0.024	0.066	0.067	*<0.005*	0.295	
16107	08/29	1.04	6.46			8.49	90	17	62	13	41						
16108	09/12	0.41	6.23			10.13	97	13	69	1	*0*						
16109	09/26	0.46	6.41			9.59	93	13	66	18	*0*						
16110	10/10	0.46	6.52			9.46	89	12	68	4	10						
16111	10/24	0.59	6.39			10.35	90	8	65	8	*0*						
	11/07	0.49	6.06			12.39	97	5	63	7	*0*						
16112	11/21	0.68	6.06			12.46	98	5	57	3	10	0.019	0.024	0.025	*<0.005*	0.260	
	12/05	0.64	5.64			13.07	97	2	68	3	*0*						
	12/18	0.55	6.26			11.31	90	4	68	6	*0*						
	AVG.	0.6	6.5			11.5	100	10	67	10	16	0.021	0.045	0.046	*<0.005*	0.278	
	MAX.	1.2	7.3			16.2	113	24	82	58	63	0.024	0.066	0.067	*<0.005*	0.295	
	MIN.	0.4	5.6			7.3	88	0	57	<1	<10	0.019	0.024	0.025	*<0.005*	0.260	
	MEDIAN	0.6	6.5			11.1	97	9	67	6	5	0.021	0.045	0.046	*<0.005*	0.278	

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

BOAT COVE BROOK -- NEAR MOUTH

DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
01/04	1.3	6.61			15.62	112	1	46	2	10						
01/17	1.52	6.8			15.74	111	1	43	4	10						
01/31	2.08	6.81			14.61	110	3	43	*0*	10						
02/14	0.83	6.61			15.76	112	1	48	*0*	*0*						
02/28	0.69	6.82			15.41	108	0	59	*0*	*0*						
03/14	3.83	6.96			13.78	109	5	47	4	10						
03/28	0.37	6.77			13.14	107	6	63	*0*	*0*						
04/11	0.55	7.11			12.73	110	8	63	8	10						
04/25	0.82	6.72			11.41	106	11	67	62	41						
05/09	0.67	6.74			10.97	103	12	70	69	63						
05/23	0.98	6.95			10.4	95	10	52	10	31						
06/06	0.9	6.69			8.94	93	16	60	16	41						
06/20	0.62	7.13			7.68	87	21	75	20	74						
07/05	1.1	6.99			7.79	87	20	73	40	41						
07/18	0.81	7.26			7.38	89	23	84	20	*0*						
08/01	0.69	7.63			6.29	75	23	96	*0*	41						
08/15	2.95	7.47			7.03	78	20	105	52	6130	0.066	0.013	0.013	*<0.005*	0.466	
08/17									84	183						
08/29	1.22	7.08			7.35	77	17	90	9	160						
10/10	0.63	6.8			8.58	83	13	118	3	10						
10/24	0.45	6.94			10.05	87	8	98	1	*0*						
11/07	0.5	6.15			10.67	88	7	91	*0*	*0*						
11/21	1.16	6.56			12.06	96	5	64	*0*	*0*	0.016	0.009	0.011	*<0.005*	0.261	
12/05	1.03	6.45			12.8	96	3	61	1	*0*						
12/18	0.6	7.05			11.06	91	6	64	*0*	*0*						
AVG.	1.1	6.9			11.1	96	10	70	16	275	0.041	0.011	0.012	BDL	0.364	
MAX.	3.8	7.6			15.8	112	23	118	84	6130	0.066	0.013	0.013	BDL	0.466	
MIN.	0.4	6.2			6.3	75	0	43	*<1*	*<10*	0.016	0.009	0.011	BDL	0.261	
MEDIAN	0.8	6.8			11.0	95	8	64	4	10	0.041	0.011	0.012	BDL	0.364	

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

GATES BROOK @ MOUTH

DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
01/04	0.11	5.08			17.95	132	2	22	*0*	*0*						
01/17	0.13	5.11			17.76	128	1	22	*0*	*0*						
01/31	0.12	5.61			17.35	133	3	22	*0*	*0*						
02/14	0.086	4.79			15.43	116	2	25	*0*	*0*						
02/28	0.11	5.53			15.88	111	0	23	*0*	*0*						
03/14	0.33	6.3			14.5	116	5	22	*0*	*0*						
03/28	0.09	6.41			14.12	119	7	23	*0*	*0*						
04/11	0.11	5.63			14.54	113	4	22	*0*	*0*						
04/25	0.12	5.2			13.59	116	7	23	*0*	*0*						
05/09	0.13	5.23			12.43	110	9	21	*0*	*0*						
05/23	0.09	5.7			12.41	108	8	21	*0*	*0*						
06/06	0.11	5.61			11.24	106	12	22	*0*	*0*						
06/20	0.1	6.28			9.99	101	15	22	2	*0*						
07/05	0.15	5.61			9.81	101	16	22	2	10						
07/18	0.12	5.95			9.68	104	18	22	*0*	10						
08/01	0.15	6.31			8.89	97	18	23	10	*0*						
08/15	0.69	6.61			9.48	100	17	25	*0*	384	0.020	0.037	0.037	*<0.005*	0.157	
08/29	0.14	6.24			10.26	105	15	26	*0*	52						
09/12	0.089	5.62			11.51	105	11	25	4	*0*						
09/26	0.11	6.23			11.19	106	12	25	13	10						
10/10	0.12								12	10						
10/24	0.1	6.29			11.33	98	8	23	3	10						
11/07	0.08	5.16			14.39	120	7	24	*0*	10						
11/21	0.11	4.91			12.88	106	6	23	*0*	*0*	0.010	*<0.005*	*<0.005*	*<0.005*	0.000	
12/05	0.1	6.34			14.68	113	4	23	*0*	*0*						
12/18	0.1	6.1			12.2	103	7	23	*0*	*0*						
AVG.	0.1	5.8			12.9	111	9	23	2	19	0.015	0.037	0.037	*<0.005*	0.079	
MAX.	0.7	6.6			18.0	133	18	26	13	384	0.020	0.037	0.037	*<0.005*	0.157	
MIN.	0.1	4.8			8.9	97	0	21	<1	<10	0.010	*<0.005*	*<0.005*	*<0.005*	0.000	
MEDIAN	0.1	5.6			12.4	108	7	23	0	0	0.015	0.037	0.037	*<0.005*	0.079	

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

(212) HOP BROOK -- GATE #22 ROAD

SORT	DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
16219	01/04	0.38	6.22			21.15	148	0	89	1	*0*						
16220	01/17	0.39	6.73			23.13	161	0	87	*0*	*0*						
	01/31	0.33	6.31			16.48	122	2	92	*0*	*0*						
16221	02/14	0.3	6.4			16.79	118	0	91	2	*0*						
16222	02/28	0.37	6.4			15.56	109	0	97	*0*	10						
16223	03/14	1.48	6.85			14.12	107	3	78	8	10						
16224	03/28	0.39	6.36			14.24	108	3	90	*0*	10						
16225	04/11	0.4	6.78			13.75	109	5	95	*0*	*0*						
16226	04/25	0.83	7.08			12.61	109	8	93	7	20						
16227	05/09	0.57	6.98			11.79	108	11	98	*0*	*0*						
16228	05/23	0.41	5.88			10.97	97	9	81	*0*	*0*						
16229	06/06	0.61	6.65			9.72	96	14	86	14	10						
16230	06/20	0.9	7.02			8.66	95	19	97	34	63						
16231	07/05	1.22	6.65			8.2	90	19	93	20	20						
16232	07/18	1.59	7.06			8	92	21	95	56	41						
16233	08/01	1.69	7.25			8.03	91	20	102	200	*0*						
16234	08/15	5.63	6.74			8.37	91	18	104	73	216	0.034	0.086	0.087	*<0.005*	0.274	
16235	08/29	1.41	6.62			8.79	91	16	105	4	41						
16236	09/12	1.15	5.82			10.7	99	11	112	*0*	10						
16237	09/26	0.93	6.45			10.1	95	11	122	1	10						
16238	10/10	0.72	6.28			10.35	94	11	112	1	*0*						
16239	10/24	0.68	6.64			10.66	91	7	96	7	10						
16240	11/07	0.46	5.56			12.58	99	5	86	1	*0*						
16241	11/21	0.52	6.28			13.6	105	4	73	32	*0*	0.010	0.056	0.058	*<0.005*	0.109	
	12/05	0.49	5.83			13.68	100	2	78	3	*0*						
	12/18	0.49	5.85			11.49	92.72	5.02	80	*0*	*0*						
	AVG.	0.9	6.5			12.4	105	9	94	18	18	0.022	0.071	0.072	BDL	0.192	
	MAX.	5.6	7.3			23.1	161	21	122	200	216	0.034	0.086	0.087	BDL	0.274	
	MIN.	0.3	5.6			8.0	90	0	73	<1	<10	0.010	0.056	0.058	BDL	0.109	
	MEDIAN	0.6	6.5			11.6	99	8	93	2	5	0.022	0.071	0.072	BDL	0.192	

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

(212A) HOP BROOK @ GATE 22

DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
01/04	0.28	6.35	6.51	4.33	22.46	158	0	79	1	*0*	0.010	0.035	0.035	*<0.005*	0.133	0.063
01/17	0.35	6.62	5.8	3.69	23.59	164	0	78	2	*0*	0.012	0.034	0.034	*<0.005*	0.116	0.073
01/31	0.31	6.56	5.87	3.96	15.15	112	2	73	*0*	*0*	0.010	0.045	0.045	*<0.005*	0.104	0.073
02/14	0.25	6.57	6.42	4.74	16.07	113	0	86	*0*	*0*	0.006	0.047	0.047	*<0.005*	0.103	0.048
02/28	0.4	6.51	8.34	6.34	15.25	106	0	94	*0*	10	*<0.005*	0.068	0.068	*<0.005*	0.136	0.046
03/14	1.77	6.77	7.44	5.53	14.22	108	3	71	2	*0*	0.016	0.100	0.101	*<0.005*	0.164	0.079
03/28	0.46	6.54	7.77	5.81	13.95	107	4	84	2	*0*		0.034	0.034	*<0.005*		0.065
04/11	0.46	6.28	7.66	5.71	13.65	109	5	82	*0*	*0*	0.006	0.023	0.023	*<0.005*	0.137	0.090
04/25	0.73	6.85	8.39	6.31	12.16	109	9	74	11	31	*<0.005*	0.010	0.011	*<0.005*	0.194	0.131
05/09	0.76	7.04	10.2	8.13	11.37	107	12	87	4	10	0.010	0.008	0.008	*<0.005*	0.232	0.139
05/23	0.55	6.06	7.44	5.49	10.73	97	10	80	6	10	0.007	*<0.005*	*<0.005*	*<0.005*	0.155	0.110
06/06	0.83	6.68	11.3	9.08	9.47	95	15	88	8	52	0.013	0.016	0.016	*<0.005*	0.196	0.166
06/20	1.4	6.81	12.5	9.95	8.21	91	19	99	8	20	0.022	0.142	0.142	*<0.005*		0.238
07/05	2.08	6.54	13.6	10.8	7.9	88	20	98	42	20	0.023	0.020	0.023	*<0.005*	0.315	0.265
07/18	2.84	6.95	17.8	14.6	7.69	89	22	99	19	41	0.030	0.021	0.023	*<0.005*	0.333	0.305
08/01	4.45	7.17	19.8	17.2	7.62	88	21	96	3	*0*	0.030	0.034	0.034	*<0.005*	0.320	0.291
08/15	9.75	7	16.1	14.2	8.4	91	18	102	1	148	0.042	0.037	0.037	*<0.005*	0.312	0.242
08/29	3.27	6.68	11.1	9.11	8.86	92	16	76	5	75	0.025	0.024	0.025	*<0.005*	0.243	0.202
09/12	2.94	6.07	16	13.1	10.38	97	11	92	6	10	0.022	0.026	0.026	*<0.005*	0.179	0.158
09/26	2.03	6.64	14.1	11.4	9.65	91	12	96	1	*0*	0.019	0.018	0.018	*<0.005*	0.158	0.139
10/10	1.26	6.18	10.6	9.02	10.17	92	11	92	1	10	0.015	0.008	0.008	*<0.005*	0.158	0.143
10/24	1	6.49	8.06	6.51	10.59	90	7	89	5	*0*	0.017	0.008	0.008	*<0.005*	0.168	0.150
11/07	0.91	5.76	8.08	5.87	12.59	98	5	95	*0*	*0*	0.013	0.012	0.013	*<0.005*	0.165	0.096
11/21	0.66	6.35	7.75	5.08	13.3	103	4	86	4	10	0.012	0.009	0.009	*<0.005*	0.125	0.111
12/05	0.59	5.69	7.73	5.57	13.75	100	1	87	*0*	*0*	0.014	0.021	0.021	*<0.005*	0.118	0.092
12/18	0.65	6.39	9.07	6.46	11.68	93	5	88	2	*0*	0.012	0.029	0.029	*<0.005*	0.105	0.077
AVG.	1.6	6.5	10.2	8.0	12.3	103	9	87	5	17	0.017	0.033	0.033	*<0.005*	0.182	0.138
MAX.	9.8	7.2	19.8	17.2	23.6	164	22	102	42	148	0.042	0.142	0.142	*<0.005*	0.333	0.305
MIN.	0.3	5.7	5.8	3.7	7.6	88	0	71	<1	<10	*<0.005*	*<0.005*	*<0.005*	*<0.005*	0.103	0.046
MEDIAN	0.8	6.6	8.4	6.4	11.5	97	8	88	2	5	0.014	0.024	0.025	*<0.005*	0.161	0.121

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

(212B) HOP BROOK @ GATE 24 (RUSSELL ROAD)

SORT	DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
16193	01/04	0.37	6.47	6.81	4.69	18.46	130	0	95	1	*0*	0.010	0.130	0.130	*<0.005*	0.103	0.052
16194	01/17	0.28	6.55	6.27	4.46	16.81	117	0	94	*0*	*0*	0.010	0.109	0.109	*<0.005*	0.071	0.055
16195	01/31	0.31	6.67	5.7	3.99	14.92	111	2	97	*0*	*0*	0.009	0.114	0.114	*<0.005*	0.081	0.058
16196	02/14	0.31	6.56	6.33	4.71	16.23	114	0	95	*0*	*0*	0.006	0.130	0.130	*<0.005*	0.108	0.040
16197	02/28	0.38	6.58	7.31	5.45	14.98	105	0	101	2	10	*<0.005*	0.154	0.154	*<0.005*	0.136	0.039
16198	03/14	1.57	6.7	6.25	4.35	13.93	106	3	83	16	31						
16199	03/15											0.014	0.198	0.200	*<0.005*	0.212	0.089
16200	03/28	0.39	6.44	8.11	6.24	14.18	107	3	95	*0*	10		0.128	0.128	*<0.005*		0.045
16201	04/11	0.36	6.97	7.3	5.34	13.52	107	5	102	*0*	*0*	*<0.005*	0.102	0.102	*<0.005*	0.093	0.058
16202	04/25	0.49	6.93	7.81	5.87	12.52	108	8	103	4	20	*<0.005*	0.067	0.067	*<0.005*	0.173	0.098
16203	05/09	0.54	6.83	9.19	7.44	11.17	102	11	105	1	*0*	0.009				0.190	0.086
16204	05/23	0.4	6.39	8.09	5.86	10.78	95	9	83	2	*0*	0.005	0.038	0.038	*<0.005*	0.119	0.083
16205	06/06	0.56	6.63	9.4	6.82	9.38	92	14	88	6	*0*	0.008	0.053	0.055	*<0.005*	0.156	0.132
16206	06/20	0.91	6.93	10.7	8.38	7.85	86	19	102	42	62	0.015	*<0.005*	*<0.005*	*<0.005*		0.146
16207	07/05	1.18	6.5	11.6	8.98	7.46	81	19	96	14	52	0.017	0.098	0.101	*<0.005*	0.244	0.160
16208	07/18	1.57	6.76	13	10.1	7.13	81	21	97	76	63	0.023	0.104	0.106	*<0.005*	0.236	0.190
	08/01	1.62	6.92	14	11.6	6.95	79	21	114	117	109	0.020	0.104	0.105	*<0.005*	0.233	0.180
	08/15	2.06	6.81	13.9	12.1	7.1	77	18	129	2	1140	0.024	0.081	0.081	*<0.005*	0.248	0.142
	08/29	1.31	6.55	11.3	9.57	8.25	86	16	118	18	41	0.017	0.059	0.059	*<0.005*	0.160	0.159
16209	09/12	1.47	5.96	13.5	11.2	9.34	87	12	130	3	*0*	0.016	0.076	0.076	*<0.005*	0.164	0.125
16210	09/26	1.25	6.27	14.7	12.1	8.72	83	12	139	7	10	0.017	0.038	0.038	*<0.005*	0.154	0.120
	10/10	0.88	5.86	12.1	10.5	9.29	85	11	123	4	10	0.013	0.030	0.030	*<0.005*	0.144	0.114
	10/24	1.04	6.39	9.41	7.81	10.18	87	7	103	3	10	0.018	0.037	0.037	*<0.005*	0.169	0.131
	11/07	0.44	5.9	9.26	6.84	12.27	97	5	86	*0*	10	0.010	0.063	0.064	*<0.005*	0.128	0.083
	11/21	0.47	6.43	8.69	5.85	13.14	102	4	72	12	20	0.011	0.071	0.071	*<0.005*	0.066	0.091
16211	12/05	0.48	5.59	8.46	6.39	13.35	98	2	78	1	*0*	0.010	0.100	0.100	*<0.005*	0.114	0.085
	12/18	0.5	6.2	9.6	7.2	11.1	90	5	80	*0*	10	0.011	0.116	0.116	*<0.005*	0.106	0.071
	AVG.	0.81	6.49	9.57	7.46	11.50	96.70	8.69	100.31	12.73	61.85	0.013	0.092	0.092	*<0.005*	0.150	0.101
	MAX.	2.1	7.0	14.7	12.1	18.5	130	21	139	117	1140	0.024	0.198	0.200	*<0.005*	0.248	0.190
	MIN.	0.3	5.6	5.7	4.0	7.0	77	0	72	<1	<10	*<0.005*	*<0.005*	*<0.005*	*<0.005*	0.066	0.039
	MEDIAN	0.5	6.6	9.2	6.8	11.2	97	8	97	3	10	0.013	0.098	0.100	*<0.005*	0.149	0.094

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

(215) EAST BR. OF FEVER BROOK -- ON WEST RD.

DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
01/04	0.35	5.38			14.49	103	1	78	*0*	*0*						
01/17	0.37	5.88			14.47	102	1	71	4	*0*						
01/31	0.33	6.3			14.46	104	1	87	*0*	0						
02/14	0.37	5.25			14.21	102	1	93	*0*	10						
02/28	0.48	5.88			13.49	96	1	115	*0*	*0*						
03/14	1.07	5.74			12.43	99	5	103	8	*0*						
03/28	0.61	6.09			12.06	103	8	90	6	*0*						
04/11	0.6	6.2			11.18	102	11	89	*0*	*0*						
04/25	1.77	6.14			11.2	105	11	103	*0*	*0*						
05/09	0.8	6.09			9.64	98	15	103	4	*0*						
05/23	0.59	5.39			9.1	89	13	82	6	41						
06/06	0.82	5.36			7.1	78	19	89	8	20						
06/20	0.61	5.7			5.88	70	23	90	4	52						
07/05	0.75	5.49			5.42	64	23	69	4	*0*						
07/18	0.71	5.59			4.59	57	25	122	8	31						
08/01	0.88	6.01			3.59	43	23	99	270	31						
08/15	0.89	6.2			4.99	55	19	100	*0*	109	0.029	0.081	0.082	*<0.005*	0.468	
08/29	0.73	5.97			5.47	58	17	109	*0*	63						
09/12	0.68	5.49			7.43	73	14	114	*0*	*0*						
09/26	0.56	5.9			6.66	66	14	133	*0*	*0*						
10/10	0.61	5.02			5.99	56	12	135	11	*0*						
10/24	0.58	5.92			8.1	70	8	128	1	10						
11/07	0.63	5.88			9.96	79	5	86	*0*	41						
11/21	0.62	4.73			9.81	77	5	63	5	*0*	0.017	*<0.005*	*<0.005*	*<0.005*	0.302	
12/05	0.48	4.64			11.67	88	3	88	*0*	*0*						
12/18	0.52	5.9			9.51	75	4	89	*0*	*0*						
AVG.	0.7	5.7			9.3	81	11	97	13	16	0.023	0.081	0.082	*<0.005*	0.385	
MAX.	1.8	6.3			14.5	105	25	135	270	109	0.029	0.081	0.082	*<0.005*	0.468	
MIN.	0.3	4.6			3.6	43	1	63	<1	<10	0.017	*<0.005*	*<0.005*	*<0.005*	0.302	
MEDIAN	0.6	5.9			9.6	78	11	92	1	0	0.023	0.081	0.082	*<0.005*	0.385	

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

WARE RIVER AND TRIBUTARIES

(101) WARE RIVER @ SHAFT #8

SORT	DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
16336	01/10	0.52	5.91			13.34	99	2.17	58		10						0.162
16337	01/18																0.187
16338	01/24	0.49	5.79			13.63	102	2.65	55	5	20						0.160
16339	02/07	0.48	6.05			16.1	117	1.02	61	6	*0*	0.011	0.048	0.048	*<0.005*	0.174	0.160
16340	02/15											0.007	0.062	0.062	*<0.005*	0.232	0.154
16341	02/21	0.54	6.97			18.47	130	0.18	84	*0*	*0*						
16342	03/01																0.125
16343	03/07	0.66	6.38			16.24	115	0.54	88	*0*	*0*	0.008	0.060	0.060	*<0.005*	0.221	0.127
16344	03/15																0.152
16345	03/21	0.8	6.88			15.09	112	2.23	80	*0*	*0*						0.134
16346	03/28																0.134
16347	04/04	1.67	6.47			13.46	117	8.43	76	5	10						0.168
16348	04/11																0.168
16349	04/18	1.7	6.38			12.64	118	11.32	88	2	*0*	0.018	*<0.005*	0.009	0.005	0.360	0.209
16350	04/25																0.211
16351	05/02	2.08	6.14			8.73	89	15.8	90	16	63						0.239
16352	05/16	1.36	6.68			11.46	103	10.03	63	23	10						0.296
16353	05/30	2.2								8	10						0.372
16354	06/13	1.42	6.98			9.82	103	16.5	72	24	52						
16355	06/27	1.82	6.12			8.46	94	19.84	56	62	98						0.458
16356	07/11	3.31	6.11			7.23	85	22.66	83	42	85						0.420
16357	07/18																0.492
16358	07/25	7.07	6.64			8.25	96	21.63	79	92	132						0.418
16359	08/01											0.053	0.056	0.058	*<0.005*	0.445	0.382
16360	08/08	3.7	6.64			7.89	91.53	21.83	85	*0*	134						0.337
16361	08/15																0.276
	08/22	3.46	6.52			9.3	101.54	18.59	93	*0*	146						0.307
	08/29																0.361
	09/05	2.19	6.19			9.12	94.99	16.95	80	92	63						0.328
	09/12																0.339
	09/19	2.04	6.45			8.51	92.34	18.3	92	29	20						0.249
	09/26																0.279
	10/03	2.02	6.06			11.25	106.94	12.39	81	66	30						0.312
	10/11																0.337
	10/17	1.34	6.12			12.15	102.81	7.71	85	12	10						0.382
	10/24																0.366
	10/31	1.42	5.93			13.1	106.87	5.72	86	60	97	0.030	0.009	0.010	*<0.005*	0.554	0.362
	11/08											0.017	0.012	0.013	*<0.005*	0.315	0.288
	11/14	1.16	6.1			11.36	100.25	9.22	74	20	20						0.348
	11/22																0.389
	11/28	0.87	6.27			13.94	109.8	4.66	72	8	*0*						0.289
	12/06																0.281
	12/12	0.9	6.26			15.45	109.27	0.9	81	2	10						0.243
	12/26	0.85	5.7			13.08	97.95	2.2	66	6	*0*						0.227
	AVG.	1.8	6.3			11.9	103.8	10.1	77	23	39	0.020	0.041	0.037	*<0.005*	0.329	0.277
	MAX.	7.1	7.0			18.5	129.7	22.7	93	92	146	0.053	0.062	0.062	0.005	0.554	0.492
	MIN.	0.5	5.7			7.2	84.8	0.2	55	<1	<10	0.007	*<0.005*	0.009	*<0.005*	0.174	0.125
	MEDIAN	1.4	6.3			12.2	102.8	9.2	80	8	15	0.017	0.052	0.048	*<0.005*	0.315	0.284

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

WARE RIVER AND TRIBUTARIES

(103A) BURNSHIRT RIVER @ RIVERSIDE CEMETERY

SORT	DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
16413	01/10	0.45	6.4			17.04	120	0.2	80	2	*0*						0.139
16414	02/07	0.45	6.62			15.99	116	0.82	56	*0*	*0*	0.011	0.054	0.054	*<0.005*	0.180	0.135
16415	03/07	0.62	6.62			15.37	108	0.24	65	*0*	20						0.109
16416	04/04	1.58	6.72			12.62	105	6.63	56	41	98						0.127
16417	04/18	1.57	5.97			11.57	105	10.12	66	34	41	0.026	0.015	0.015	*<0.005*	0.386	0.230
16418	05/02	1.49	5.95			9.45	93	13.95	65	11	41						0.170
16419	05/16	1.13	6.71			10.65	96	9.91	57	43	31						0.250
16420	05/30	1.72								12	52						0.267
16421	06/13	1.1	6.56			7.44	79	17	56	12	10						0.280
16422	06/27	1.37	6			7.81	85	19.03	52	64	86						0.402
16423	07/11	2.36	5.98			6.71	76	20.96	66	44	41						0.375
16424	07/25	2.48	6.43			7.43	82	19.32	58	42	74						0.360
16425	08/08	2.91	6.33			6.43	73	21.09	59	89	131	0.035	0.043	0.044	*<0.005*	0.324	0.329
16426	08/22	1.99	6.45			7.88	84	17.6	58	30	110						0.333
16427	09/05	1.68	6.09			7.37	74	15.37	58	44	73						0.273
16428	09/19	1.82	6.31			7.56	79	16.59	63	52	63						0.259
16429	10/03	1.21	5.56			10.6	97	10.83	58	60	96						0.289
16430	10/17	0.92	6.35			10.89	88	6.06	61	13	20						0.308
16431	11/14	0.66	5.54			10.24	90	8.97	55	14	31						0.294
16432	11/28	0.53	5.55			12.6	100	4.85	56	*0*	10						0.248
16433	12/12	0.59	5.76			14.05	98.77	0.69	61	2	*0*						0.208
16434	12/26	0.92	5.57			13.2	99	2.41	55	2	*0*						0.204
	AVG.	1.3	6.2			10.6	93	11	60	28	47	0.024	0.037	0.038	*<0.005*	0.297	0.254
	MAX.	2.9	6.7			17.0	120	21	80	89	131	0.035	0.054	0.054	*<0.005*	0.386	0.402
	MIN.	0.5	5.5			6.4	73	0	52	<1	<10	0.011	0.015	0.015	*<0.005*	0.180	0.109
	MEDIAN	1.3	6.3			10.6	93	10	58	22	41	0.026	0.043	0.044	*<0.005*	0.324	0.263

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

WARE RIVER AND TRIBUTARIES

(116) ASNACOMET POND @ OUTLET

SORT	DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
16465	01/10	0.36	5.74	3.88	1.99	12.69	91	0.89	42	*0*	*0*	0.006	0.045	0.045	*<0.005*	0.318	0.054
16466	01/24	0.36	5.48	4.53	2.46	13.49	97	1.39	43	*0*	*0*	0.006	0.024	0.024	*<0.005*	*<0.005*	0.054
16467	02/07	0.38	6.1	4.25	2.21	13.46	104	3.21	33	*0*	*0*	0.006	0.024	0.024	*<0.005*	0.155	0.055
16468	03/07	0.33	6.64	4.53	2.45	12.69	100	4.56	34	*0*	*0*	*<0.005*	0.023	0.023	*<0.005*	0.165	0.052
16469	03/21	0.44	6.09	4.89	2.67	13.51	99	1.68	34	*0*	*0*	*<0.005*	0.034	0.034	*<0.005*		0.054
16470	04/04	0.46	6.78	4.54	2.37	12.82	106	6.26	33	*0*	*0*	0.006	0.032	0.032	*<0.005*	0.187	0.057
16471	04/18	0.49	6.33	4.25	2.25	11.93	111	10.96	36	*0*	*0*	*<0.005*	0.008	0.008	*<0.005*	0.192	0.051
16472	05/02	0.35	6.47	4.28	2.21	9.87	99	15.22	35	388	374	*<0.005*	*<0.005*	*<0.005*	*<0.005*	0.158	0.048
16473	05/16	0.35	6.91	4.14	2.15	10.28	96	11.57	34	9	*0*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	0.170	0.046
16474	05/30	0.36		5.2	2.58					*0*	*0*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	0.208	0.049
	06/13	0.41	6.7	4.34	2.33	8.72	96	18.77	34	*0*	*0*	0.010	*<0.005*	*<0.005*	*<0.005*	0.195	0.056
	06/27	0.36	6.78	6.99	3.13	8.18	96	22.67	34	14	20	0.005	*<0.005*	*<0.005*	*<0.005*		0.062
	07/11	0.34	7.11	4.82	2.26	8.04	96	23.73	36	4	10	*<0.005*	*<0.005*	*<0.005*	*<0.005*	0.184	0.059
	07/25	0.42	6.53	4.1	1.95	7.3	90	24.74	35	*0*	31	0.006	*<0.005*	*<0.005*	*<0.005*	0.185	0.057
	08/08	0.4	7.0	3.7	1.4	6.4	79	25	34	*0*	*0*	0.007	*<0.005*	*<0.005*	*<0.005*	0.202	0.053
	09/05	1.0	6.7	5.4	2.6	7.8	86	19	34	32	31	0.013	*<0.005*	*<0.005*	*<0.005*	*<0.005*	0.049
	10/03	0.39	6.08	5.46	2.1	9.8	101	15.99	34	15	10	0.009	*<0.005*	*<0.005*	*<0.005*	0.168	0.044
	11/14	0.67	5.77	4.99	2.35	9.74	87	9.78	34	6	10	0.009	*<0.005*	*<0.005*	*<0.005*	0.200	0.053
	11/28	0.41	4.96	5.12	2.61	10.41	88.86	7.87	35	*0*	*0*	0.009	*<0.005*	*<0.005*	*<0.005*	0.148	0.056
	12/12	0.44	5.43	4.97	2.49	11.25	89	4.9	35	*0*	*0*	0.008	0.006	0.006	*<0.005*	0.173	0.056
	12/26	0.34	5.65	3.55	1.87	11.1	88	4.07	33	2	*0*	0.009	0.011	0.011	*<0.005*	0.190	0.060
	AVG.	0.4	6.3	4.7	2.3	10.5	95	11.6	35	22	23	0.008	0.023	0.023	*<0.005*	0.188	0.054
	MAX.	1.0	7.1	7.0	3.1	13.5	111	25.1	43	388	374	0.013	0.045	0.045	*<0.005*	0.318	0.062
	MIN.	0.3	5.0	3.6	1.4	6.4	79	0.9	33	<1	<10	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	0.044
	MEDIAN	0.4	6.4	4.5	2.3	10.3	96	10.4	34	0	0	0.007	0.024	0.024	*<0.005*	0.185	0.054

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

WARE RIVER AND TRIBUTARIES

(116B) COMET POND OUTLET TRIB @ RT. 62 NEAR CLARK RD

SORT	DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
16465	01/10	0.4	6.27	3.96	1.82	16.26	118	1.43	36	*0*	*0*	0.016	0.024	0.024	*<0.005*	0.340	0.160
16466	01/24	0.35	6.13	3.77	1.61	16.11	120	2.48	38	*0*	10	0.011	0.024	0.024	*<0.005*	0.165	0.129
16467	02/07	0.39	5.42	2.97	0.88	12.51	93	1.86	42	*0*	*0*	0.011	0.020	0.020	*<0.005*	0.184	0.181
16468	02/21	0.46	5.49	4.18	2.06	11.58	84	1.38	46	*0*	*0*	0.008	0.023	0.023	*<0.005*	0.243	0.145
16469	03/07	0.75	6.13	4.64	2.48	9.98	73	1.79	47	*0*	*0*	0.015	0.025	0.025	*<0.005*	0.279	0.151
16470	03/21	0.81	5.36	6.42	4.21	9.26	70	3.17	46	*0*	10	0.013	0.015	0.015	*<0.005*		0.153
16471	04/04	1.23	5.49	4.47	2.23	7.75	66	7.81	46	101	109	0.040	0.016	0.017	*<0.005*	0.438	0.250
16472	04/18	0.74	5.42	4.58	2.5	5.18	45	8.01	72	24	20	0.032	*<0.005*	*<0.005*	*<0.005*	0.390	0.278
16473	05/02	1	5.66	4.5	2.38	7.07	71	15.18	44	23	10	0.020	0.007	0.007	*<0.005*	0.443	0.332
16474	05/16	1.78	5.03	3.1	0.88	8.26	75	10.11	41	11	*0*	0.030	*<0.005*	0.006	*<0.005*	0.380	0.459
	05/30	1.25		5.1	2.12					71	119	0.039	*<0.005*	*<0.005*	*<0.005*	0.478	0.374
	06/13	0.72	5.47	3.6	1.41	6.26	68	17.85	38	22	31	0.024	*<0.005*	*<0.005*	*<0.005*	0.304	0.341
	06/27	0.76	5.64	7.69	4.26	5.07	58	20.99	39	62	52	0.033	*<0.005*	*<0.005*	*<0.005*		0.467
	07/11	1.3	5.33	6.33	3.87	2.6	30	21.21	46	19	*0*	0.044	*<0.005*	*<0.005*	*<0.005*	0.658	0.482
	07/25	0.9	5.7	6.5	4.3	1.4	16	21	57	5	*0*	0.056	*<0.005*	*<0.005*	*<0.005*	0.649	0.490
	08/08	1.8	5.8	7.2	4.9	1.1	13	22	77	3	31	0.082	*<0.005*	*<0.005*	*<0.005*	0.890	0.630
	08/22	1.36	5.68	6.79	4.5	1.36	15	18.41	79	2	20	0.058	*<0.005*	*<0.005*	*<0.005*		0.634
	09/05	0.92	5.21	6.97	3.97	2.81	29	15.98	73	17	30	0.054	*<0.005*	*<0.005*	*<0.005*	*<0.005*	0.737
	09/19	1.38	5.49	7.35	4.71	2.04	21.97	17.87	103	8	20	0.056	*<0.005*	*<0.005*	*<0.005*	0.791	0.728
	10/03	0.92	5.24	7.27	4.44	4.19	38.77	11.17	110	1	*0*	0.046	*<0.005*	*<0.005*	*<0.005*	0.638	0.642
	10/17	0.7	5.69	5.18	3.28	5.62	46.26	6.6	87	3	*0*	0.040	*<0.005*	*<0.005*	*<0.005*	0.532	0.802
	11/14	0.72	4.69	3.83	1.04	6.87	59.98	8.78	51	3	10	0.032	*<0.005*	*<0.005*	*<0.005*	0.505	0.739
	11/28	0.4	4.03	4.01	1.52	9.97	80	5.49	40	*0*	*0*	0.012	*<0.005*	*<0.005*	*<0.005*	0.258	0.298
	12/12	0.4	4.1	4.8	2.3	10.7	77	1.8	52	*0*	*0*	0.016	*<0.005*	*<0.005*	*<0.005*	0.269	0.288
	12/26	0.5	5.1	3.1	1.0	10.7	80	2.1	40	*0*	10	0.022	0.009	0.010	*<0.005*	0.249	0.280
AVG.		0.9	5.4	5.1	2.7	7.3	60	10	56	15	19	0.032	0.018	0.017	*<0.005*	0.433	0.407
MAX.		1.8	6.3	7.7	4.9	16.3	120	22	110	101	119	0.082	0.025	0.025	*<0.005*	0.890	0.802
MIN.		0.4	4.0	3.0	0.9	1.1	13	1	36	<1	<10	0.008	*<0.005*	*<0.005*	*<0.005*	*<0.005*	0.129
MEDIAN		0.8	5.5	4.6	2.4	7.0	67	8	46	3	10	0.032	0.020	0.019	*<0.005*	0.390	0.341

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

WARE RIVER AND TRIBUTARIES

(107A) WEST BR. OF WARE RIVER @ BRIGHAM ROAD

DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
02/07	0.44	6.01			15.36	109	0.32	57	*0*	20	0.011	0.068	0.068	*<0.005*	0.218	0.217
02/21	0.44	5.8			14.8	103	0.01	63	*0*	*0*						0.200
03/07	0.6	6.43			14.65	102	0.08	63	*0*	*0*						0.195
03/21	0.66	6			14.98	105	0.08	64	*0*	*0*						0.183
04/04	1.29	6.49			12.09	102	7.24	63	9	20						0.224
04/18	1.02	6.08			11.53	107	10.91	62	4	*0*	0.019	0.008	0.008	*<0.005*	0.339	0.283
05/02	1.41	6.18			8.9	89	15.07	60	4	20						0.323
05/16	1.11	6.83			9.76	89	10.33	58	23	*0*						0.405
05/30	1.69								28	31						0.484
06/27	0.97	6.59			6.7	75	19.91	48	60	85						0.628
07/11	2.03	6.19			7.07	81	21.61	61	17	20						0.556
07/25	2.41	6.31			7.62	86	20.54	63	16	86						0.547
08/08	2.43	6.74			6.65	77	21.48	63	48	31	0.048	0.090	0.092	*<0.005*	0.474	0.487
08/22	2.34	6.04			8.4	90	17.91	85	64	197						0.498
09/05	1.35	5.77			8.23	83	15.63	71	37	10						0.640
09/19	1.4	7			8.2	87	17.03	65	36	63						0.456
10/03	1.45	5.5			11.45	105	10.99	68	42	52						0.538
10/17	0.97	6.12			10.73	87	6.19	66	3	*0*						0.557
11/14	0.87	5.94			9.7	85	8.98	60	20	20						0.509
11/28	0.72	5.57			12.15	96	4.67	55	1	*0*						0.406
12/12	0.84	6.04			13.8	96.68	0.57	63	1	*0*						0.325
12/26	0.78	5.35			12.2	91	2.07	58	5	*0*						0.324
AVG.	1.2	6.1			10.7	93	10.1	63	19	30	0.026	0.055	0.056	*<0.005*	0.344	0.408
MAX.	2.4	7.0			15.4	109	21.6	85	64	197	0.048	0.090	0.092	*<0.005*	0.474	0.640
MIN.	0.4	5.4			6.7	75	0.0	48	<1	<10	0.011	0.008	0.008	*<0.005*	0.218	0.183
MEDIAN	1.1	6.1			10.7	90	10.3	63	13	20	0.019	0.068	0.068	*<0.005*	0.339	0.431

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

WARE RIVER AND TRIBUTARIES

(108) EAST BR. OF WARE RIVER @ NEW BOSTON

DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
01/10	0.52	6.63			19.15	135	0.22	61	3	*0*						0.168
01/24	0.51	6.44			17.63	123	0.24	76	1	*0*						0.144
02/07	0.52	6.21			15.72	113	0.56	56	2	10	0.010	0.048	0.048	*<0.005*	0.276	0.157
02/21	0.48	6.28			14.75	104	0.46	68	2	20						0.130
03/07	0.69	6.77			14.65	103	0.26	72	*0*	*0*						0.129
03/21	0.99	6.26			14.34	102	0.62	68	*0*	10						0.128
04/04	1.59	6.31			11.01	94	7.71	72	7	*0*						0.164
04/18	1.54	6.26			9.69	92	11.9	81	2	*0*	0.019	0.020	0.020	*<0.005*	0.327	0.208
05/02	1.89	6.31			8.65	86	14.75	73	3	*0*						0.239
05/16	0.96	6.09			9.87	90	10.31	54	11	52						0.250
05/30	2.01								32	97						0.300
06/13	1.11	6.21			7.93	86	18.42	54	26	*0*						0.275
06/27	1.35	6.17			6.5	74	21.28	52	40	52						0.366
07/11	3.37	6.3			6.52	75	21.44	65	64	41						0.383
07/25	4.02	6.43			5.69	66	21.82	73	44	63						0.413
08/08	3.74	6.52			4.19	49	22.45	79	405	30	0.040	0.041	0.042	*<0.005*	0.461	0.375
08/22	2.79	6.37			5.03	56	19.24	83	255	52						0.306
09/05	1.78	6.05			6.54	68	16.48	76	100	31						0.321
09/19	2.57	6.37			6.11	65	17.66	85	83	98						0.312
10/03	1.96	5.8			8.54	80	11.69	81	82	121						0.291
10/17	1.14	6.14			9.12	75	6.69	80	8	20						0.324
11/14	0.9	5.51			9.55	84	9.21	56	6	20						0.331
11/28	0.68	4.87			11.73	93.03	4.93	56	4	*0*						0.272
12/12	0.82	5.43			12.83	90	0.69	70	18	41						0.230
12/26	0.9	5.59			11.68	87.46	2.21	59	16	20						0.212
AVG.	1.6	6.2			10.2	87	10	69	50	32	0.023	0.036	0.037	*<0.005*	0.355	0.259
MAX.	4.0	6.8			19.2	135	22	85	405	121	0.040	0.048	0.048	*<0.005*	0.461	0.413
MIN.	0.5	4.9			4.2	49	0	52	<1	<10	0.010	0.020	0.020	*<0.005*	0.276	0.128
MEDIAN	1.2	6.3			9.6	86	10	72	10	20	0.019	0.041	0.042	*<0.005*	0.327	0.274

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

WARE RIVER AND TRIBUTARIES

(108A) EAST BR. OF WARE RIVER @ ROUTE 68

DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
01/10	0.5	6.45	4.87	2.93	14.97	109	1.31	30	*0*	*0*	0.014	0.088	0.090	*<0.005*	0.232	0.158
01/24	0.47	6.44	4.03	1.93	16.59	128	3.99	34	*0*	*0*	0.011	0.067	0.067	*<0.005*	0.182	0.144
02/07	0.44	5.94	3.98	1.94	14.82	106	0.61	50	4	*0*	0.010	0.048	0.048	*<0.005*	0.282	0.155
02/21	0.45	6.12	4.83	2.76	14.05	100	0.82	61	*0*	*0*	0.006	0.078	0.078	*<0.005*	0.233	0.130
03/07	0.63	6.75	5.87	3.8	14.25	102	0.9	62	*0*	*0*	0.009	0.083	0.083	*<0.005*	0.218	0.127
03/21	0.92	6.29	5.5	3.38	13.93	102	1.74	62	6	10	0.010	0.053	0.053	*<0.005*		0.131
04/04	1.4	6.44	6.69	4.48	10.46	92	8.91	73	*0*	*0*	0.024	0.030	0.030	*<0.005*	0.379	0.171
04/18	1.58	6.26	6.96	5.02	9.09	89	13.07	73	10	*0*	0.022	0.009	0.009	*<0.005*	0.430	0.222
05/02	2.73	6.23	7.89	5.68	8.78	90	16.09	62	4	20	0.010	0.006	0.006	*<0.005*	0.368	0.232
05/16	0.86	5.7	4.51	2.69	8.86	81	10.31	48	34	*0*	0.013	*<0.005*	0.006	*<0.005*	0.329	0.240
05/30	1.9		8.26	5.59					10	31	0.024	*<0.005*	*<0.005*	*<0.005*	0.406	0.293
06/13	0.91	6.01	5.52	3.37	5.97	65	18.6	48	32	52	0.018	*<0.005*	*<0.005*	*<0.005*	0.298	0.260
06/27	1.11	5.74	8.04	4.21	4.98	57	21.15	48	80	52	0.024	0.009	0.012	*<0.005*		0.340
07/11	1.98	5.89	8.87	6.23	5.29	63	23.43	59	216	109	0.037	0.021	0.024	*<0.005*	0.459	0.353
07/25	2.29	6.18	9.25	7.13	5.2	61	22.14	67	102	75	0.042	0.018	0.020	*<0.005*	0.472	0.392
08/08	2.17	6.4	11.2	9.02	4.23	51	23.41	76	50	189	0.033	0.013	0.014	*<0.005*	0.383	0.348
08/22	1.68	6.23	10.2	8.35	6.4	72	19.77	72	6	84	0.035	0.008	0.008	*<0.005*		0.247
09/05	1.38	5.77	9.63	6.77	6.69	69	16.61	69	9	31	0.027	*<0.005*	*<0.005*	*<0.005*	0.342	0.312
09/19	1.29	6.12	11	8.29	6.21	67	18.23	81	54	*0*	0.024	0.008	0.008	*<0.005*	0.375	0.285
10/03	1.53	5.61	10.9	7.64	7.72	73	12.36	76	42	20	0.024	*<0.005*	*<0.005*	*<0.005*	0.327	0.247
10/17	1.06	5.56	6.45	4.72	8.08	68	7.24	72	21	*0*	0.023	*<0.005*	*<0.005*	*<0.005*	0.392	0.371
11/14	0.94	5.43	5.34	2.83	8.88	78	9.09	49	9	*0*	0.018	0.012	0.012	*<0.005*	0.302	0.306
11/28	0.77	4.85	5.29	2.86	11.11	89	5.18	49	9	*0*	0.014	0.018	0.018	*<0.005*	0.269	0.249
12/12	0.82	5.33	6.33	3.95	12.1	84	0.3	61	4	20	0.016	0.057	0.058	*<0.005*	0.243	0.212
12/26	0.89	5.51	4.74	2.99	11.57	86.19	2.03	52	2	20	0.020	0.053	0.053	*<0.005*	0.264	0.197
AVG.	1.2	6.0	7.0	4.7	9.6	83	11	60	28	29	0.020	0.036	0.035	*<0.005*	0.327	0.245
MAX.	2.7	6.8	11.2	9.0	16.6	128	23	81	216	189	0.042	0.088	0.090	*<0.005*	0.472	0.392
MIN.	0.4	4.9	4.0	1.9	4.2	51	0	30	<1	<10	0.006	*<0.005*	*<0.005*	*<0.005*	0.182	0.127
MEDIAN	1.1	6.1	6.5	4.2	8.9	82	10	62	9	10	0.020	0.021	0.022	*<0.005*	0.328	0.247

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

WARE RIVER AND TRIBUTARIES

(108B) CUSHING POND OUTLET - BEMIS ROAD

SORT	DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
16545	01/10	0.58	6.57	5.42	3.52	15.18	107	0.14	58	*0*	*0*	0.016	0.089	0.089	*<0.005*	0.330	0.246
16546	01/24	0.68	6.07	5	2.89	15.58	108	0.06	54	*0*	*0*	0.014	0.089	0.089	*<0.005*	0.268	0.205
16547	02/07	0.58	5.65	4.41	2.41	12.57	95	2.64	55	*0*	*0*	0.012	0.102	0.102	*<0.005*	0.293	0.166
16548	02/21	0.52	5.75	5.02	2.86	11.87	93	4.06	70	4	*0*	0.007	0.168	0.168	*<0.005*	0.249	0.142
16549	03/07	0.46	5.94	5.18	3.23	12.02	93	3.92	67	*0*	*0*	0.007	0.093	0.093	*<0.005*	0.219	0.136
16550	03/21	0.42	5.93	5.13	2.94	13.35	100	2.39	69	*0*	*0*	0.005	0.166	0.166	*<0.005*		0.090
16551	04/04	0.44	6.37	5.18	3	10.39	92	9.24	60	*0*	*0*	0.022	0.057	0.057	*<0.005*	0.297	0.102
16552	04/18	0.6	6.01	4.73	2.72	9.27	90	12.93	64	*0*	10	0.012	0.034	0.034	*<0.005*	0.294	0.092
16553	05/02	1.3	6.59	6.12	4.08	9.24	97	17.15	66	9	*0*	0.005	0.091	0.091	*<0.005*	0.358	0.107
16554	05/16	1.23	5.8	4.14	2.04	9.98	91	10.49	55	6	*0*	0.018	0.025	0.029	*<0.005*	0.433	0.161
16555	05/30	1.17		5.42	2.88					4	10	0.015	0.017	0.017	*<0.005*	0.354	0.188
16556	06/19											0.027	0.120	0.121	*<0.005*	0.460	0.288
16557	06/27	1.46	6.28	7.56	4.04	6.75	80	23.37	58	14	41	0.027	0.020	0.023	*<0.005*		0.310
16558	07/11	1.21	6.84	6.55	4.11	6.69	80	23.54	73	7	*0*	0.027	0.028	0.030	*<0.005*	0.500	0.352
16559	07/25	1.63	6.23	6.94	4.92	5.46	65	22.66	75	3	10	0.035	0.075	0.078	*<0.005*	0.566	0.327
16560	08/08	1.07	6.35	6.88	4.74	5.44	65	23.34	72	1	*0*	0.027	0.069	0.070	*<0.005*	0.491	0.363
16561	08/22	1.82	6.32	7.35	5.22	6.8	77	20.44	80	*0*	31	0.025	0.127	0.128	*<0.005*		0.272
16562	09/05	1.02	5.83	7.07	4.39	7.03	74	17.17	76	29	41	0.020	0.088	0.088	*<0.005*	0.000	0.222
16563	09/19	1.07	6.24	7.76	5.41	6.53	71	18.56	81	9	10	0.019	0.083	0.083	*<0.005*	0.362	0.178
	10/03	1.14	5.1	4.34	1.48	8.32	81	13.34	64	58	109	0.025	*<0.005*	*<0.005*	*<0.005*	0.486	0.287
	10/17	0.94	4.83	2.31	0.5	7.63	67	9.3	66	9	10	0.021	*<0.005*	*<0.005*	*<0.005*	0.446	0.318
	11/14	1.32	5.28	4.49	2.09	9.04	80	9.19	54	*0*	*0*	0.028	0.042	0.042	*<0.005*	0.635	0.273
	11/28	0.94	4.92	5.83	3.44	11.31	90	4.99	57	*0*	*0*	0.020	0.066	0.066	*<0.005*	0.533	0.288
16564	12/12	1.03	5.47	5.72	3.41	12.46	92	2.47	62	*0*	10	0.025	0.096	0.097	*<0.005*	0.617	0.289
16565	12/26	0.88	5.62	4.79	3.01	11.22	86	3.24	58	*0*	*0*	0.027	0.112	0.113	*<0.005*	0.565	0.257
	AVG.	1.0	5.9	5.6	3.3	9.7	86	11	65	6	12	0.020	0.081	0.082	*<0.005*	0.398	0.226
	MAX.	1.8	6.8	7.8	5.4	15.6	108	24	81	58	109	0.035	0.168	0.168	*<0.005*	0.635	0.363
	MIN.	0.4	4.8	2.3	0.5	5.4	65	0	54	<1	<10	0.005	*<0.005*	*<0.005*	*<0.005*	0.000	0.090
	MEDIAN	1.0	5.9	5.3	3.1	9.3	90	9	64	1	0	0.020	0.088	0.088	*<0.005*	0.398	0.246

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

WARE RIVER AND TRIBUTARIES

(108C) EAST BRANCH WARE RIVER (BICKFORD) - LOMBARD ROAD

SORT	DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
16545	01/10	0.38	6.75	3.26	1.3	17.33	122	0.12	67	*0*	*0*	0.010	0.035	0.035	*<0.005*	0.250	0.129
16546	01/24	0.32	6.33	3.63	1.57	20.27	141	0.04	61	*0*	*0*	0.008	0.036	0.037	*<0.005*	0.194	0.118
16547	02/07	0.32	5.7	3.36	1.3	14.73	112	2.67	38	*0*	*0*	0.016	0.046	0.046	*<0.005*	0.254	0.102
16548	02/21	0.28	6.14	4.46	2.43	14.06	109	3.92	41	*0*	*0*	*<0.005*	0.062	0.062	*<0.005*	0.196	0.105
16549	03/07	0.33	6.3	4.26	2.01	13.34	105	4.37	41	*0*	*0*	0.005	0.058	0.058	*<0.005*	0.180	0.099
16550	03/21	0.35	6.21	4.88	2.65	14.98	107	0.9	42	*0*	*0*	*<0.005*	0.061	0.061	*<0.005*		0.088
16551	04/04	0.67	6.2	4.69	2.51	12.79	106	6.63	41	*0*	*0*	0.010	0.048	0.048	*<0.005*	0.203	0.088
16552	04/18	0.65	6.29	4.8	2.81	11.38	106	11.03	44	6	*0*	0.006	0.035	0.035	*<0.005*	0.190	0.077
16553	05/02	0.7	6.56	5.17	3	9.63	96	14.9	42	4	*0*	*<0.005*	0.033	0.033	*<0.005*	0.166	0.072
16554	05/16	0.58	5.71	3.81	1.78	10.34	95	10.86	39	3	20	0.006	0.011	0.015	*<0.005*	0.198	0.089
16555	05/30	0.49		5.37	2.94					6	*0*	*<0.005*	0.012	0.012	*<0.005*	0.192	0.081
16556	06/13	0.65	6.2	4.01	1.89	8.39	93	19.18	40	*0*	20	0.008	*<0.005*	*<0.005*	*<0.005*	0.259	0.100
16557	06/27	0.93	7	6.39	2.69	7.85	89	20.75	35	40	63	0.016	*<0.005*	0.006	*<0.005*		0.177
16558	07/11	0.56	6.81	6.14	3.66	7.94	92	22.28	43	*0*	*0*	0.008	0.027	0.028	*<0.005*	0.221	0.100
16559	07/25	0.72	6.92	5.95	3.84	7.27	84	21.34	44	32	110	0.010	0.026	0.027	*<0.005*	0.222	0.102
16560	08/08	2.53	7.21	8.58	6.47	7.48	82	19.24	48	*0*	31	0.013	0.062	0.062	*<0.005*	0.168	0.079
16561	08/22	1.68	7.04	14.9	13.3	9.25	95	15.74	55	*0*	30	0.015	0.123	0.123	*<0.005*		0.077
16562	09/05	1.42	6.56	16.1	13.3	8.93	87	13.78	55	12	*0*	0.011	0.097	0.097	*<0.005*	*<0.005*	0.073
16563	09/19	1.45	7.08	16.2	13.2	8.38	86	15.81	58	7	*0*	0.012	0.105	0.105	*<0.005*	0.093	0.070
16564	10/03	1.49	6.3	16.7	13.8	10.85	97	9.57	57	4	10	0.013	0.031	0.031	*<0.005*	0.107	0.099
	10/17	1.92	6.67	14.6	12.8	10.31	85	6.83	57	1	*0*	0.012	0.036	0.036	*<0.005*	0.120	0.083
	11/14	0.93	6.29	5.12	2.34	10.25	90	8.88	37	9	*0*	0.010	0.094	0.009	*<0.005*	0.240	0.128
16565	11/28	0.93	5.3	5	2.45	11.6	96	6.73	36	*0*	10	0.013	0.011	0.011	*<0.005*	0.221	0.132
16566	12/12	0.77	5.5	4.79	2.5	12.87	97	3.18	37	*0*	*0*	0.009	0.021	0.021	*<0.005*	0.208	0.126
	12/26	0.8	5.7	3.8	2.1	11.9	91	3	35	*0*	*0*	0.014	0.030	0.030	*<0.005*	0.268	0.128
	AVG.	0.9	6.4	7.0	4.7	11.3	99	10	46	5	12	0.011	0.048	0.043	*<0.005*	0.198	0.101
	MAX.	2.5	7.2	16.7	13.8	20.3	141	22	67	40	110	0.016	0.123	0.123	*<0.005*	0.268	0.177
	MIN.	0.3	5.3	3.3	1.3	7.3	82	0	35	<1	<10	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	0.070
	MEDIAN	0.7	6.3	5.0	2.7	10.6	96	9	42	0	0	0.010	0.036	0.035	*<0.005*	0.198	0.099

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006

WARE RIVER AND TRIBUTARIES

(121A) THAYER POND AT OUTLET

DATE	TURB	pH	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	FECCOLI	Ecoli	TPH	NO3-	NO3-/NO2-	NO2-	TKN	UV254
02/07	1.59	6.05			10.51	81	3.01	221	*0*	10	0.013	0.161	0.161	*<0.005*	0.192	0.123
02/21	1.35	5.98			8.61	68	4.69	272	*0*	*0*						0.120
03/07	1.78	6.12			5.11	40	4.62	356	*0*	*0*						0.113
03/21	1.07	6.37			11.97	93	4.1	353	*0*	*0*						0.081
04/04	1.53	6.64			9.56	86	9.74	369	3	*0*						0.086
04/18	0.85	6.28			7.86	80	15.11	406	2	*0*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	0.336	0.102
05/02	0.73	6.23			5.57	58	16.69	240	3	*0*						0.113
05/16	0.93	6.16			9.53	86	10.13	295	6	41						0.139
05/30	0.88								4	20						0.173
06/13	0.66	6.1			5.7	67	22	201	8	10						0.224
06/27	0.77	6.2			3.45	41	23.17	239	*0*	*0*						0.303
07/11	0.64	6.43			3.95	47	23.55	274	6	*0*						0.337
07/25	0.78	6.08			0.2	2	21.75	221	*0*	*0*						0.332
08/08	0.87	6.18			1.3	16	23.28	294	22	134	0.019	*<0.005*	0.005	*<0.005*	0.458	0.340
08/22	0.92	6.16			1.59	18	20.95	314	62	10						0.335
09/05	1.03	5.86			3.65	39	18.19	300	5	10						0.288
10/03	0.8	5.65			3.56	35	13.93	364	1	10						0.287
11/14	1.56	6.13			8.62	76	9.14	267	*0*	*0*						0.253
11/28	1.53	5.2			9.53	76	5.1	172	*0*	30						0.282
12/12	1.15	5.43			8.15	61	3.11	218	11	63						0.276
12/26	1.49	5.79			9.82	75	2.81	246	*0*	*0*						0.217
AVG.	1.1	6.1			6.4	57	13	281	6	16	0.016	0.161	0.083	*<0.005*	0.329	0.215
MAX.	1.8	6.6			12.0	93	24	406	62	134	0.019	0.161	0.161	*<0.005*	0.458	0.340
MIN.	0.6	5.2			0.2	2	3	172	<1	<10	*<0.005*	*<0.005*	*<0.005*	*<0.005*	0.192	0.081
MEDIAN	0.9	6.1			6.8	64	12	273	2	0	0.016	0.161	0.083	*<0.005*	0.336	0.224

NOTE: VALUES SHOWN IN ITALICS ARE BELOW METHOD DETECTION LIMIT (MDL).
FECAL COLIFORM MDL =1 CFU/100mL; ECOLI MDL =10 CFU/100mL.

QUABBIN LABORATORY RECORDS 2006
M.W.R.A. WINSOR DISINFECTION STATION

DATE	WDFR			
	pH	**TEMPC**	**TOTCOLI**	**FECCOLI**
01/01	7.00	6.0	4	1
01/02	6.50	6.1	2	0
01/03	7.00	5.2	2	1
01/04	6.50	5.3	7	2
01/05	6.80	5.6	6	1
01/06	6.60	5.4	4	3
01/07	6.50	5.0	8	1
01/08	6.40	5.0	2	1
01/09	6.90	4.9	3	1
01/10	6.50	4.9	6	0
01/11	6.50	5.2	3	1
01/12	6.60	5.0	2	0
01/13	6.50	5.1	1	0
01/14	6.40	5.3	4	0
01/15	6.60	4.7	44	1
01/16	6.30	3.9	15	0
01/17	6.80	4.2	4	1
01/18	6.50	5.6	10	3
01/19	7.10	4.3	13	1
01/20	6.40	4.4	5	0
01/21	6.40	4.6	5	2
01/22	6.40	4.2	6	0
01/23	6.80	3.9	2	2
01/24	6.40	4.1	5	1
01/25	6.50	3.8	2	0
01/26	6.60	3.9	1	0
01/27	6.40	3.4	3	1
01/28	6.40	3.8	2	0
01/29	6.60	4.3	1	0
01/30	6.70	3.5	1	0
01/31	6.50	3.5	2	0
02/01	6.30	4.2	5	1
02/02	6.70	3.6	5	2
02/03	6.30	3.7	3	1
02/04	6.40	3.5	2	0
02/05	6.20	3.9	2	0
02/06	6.90	3.4	1	0
02/07	6.60	3.7	1	0
02/08	6.50	3.1	3	0
02/09	6.70	3.3	1	0
02/10	6.60	3.2	1	0
02/11	6.50	2.9	2	0
02/12	6.70	3.2	1	0
02/13	6.60	3.0	1	1
02/14	6.70	3.0	0	0
02/15	6.60	2.7	2	0
02/16	6.70	3.4	1	0
02/17	6.50	2.8	0	0
02/18	6.60	2.7	2	0
02/19	6.60	2.6	3	1
02/20	6.60	2.6	0	0
02/21	6.80	2.7	0	0
02/22	6.60	2.4	2	0

QUABBIN LABORATORY RECORDS 2006
M.W.R.A. WINSOR DISINFECTION STATION

DATE	WDFR			
	pH	**TEMPC**	**TOTCOLI**	**FECCOLI**
02/23	6.80	2.7	1	0
02/24	6.50	2.7	2	0
02/25	6.60	2.4	1	0
02/26	6.70	2.1	1	0
02/27	6.80	2.1	1	0
02/28	6.60	1.7	0	0
03/01		2.4	1	0
03/02		1.9	1	0
03/03		1.7	3	0
03/04		1.4	1	1
03/05		1.9	1	0
03/06		2.1	1	1
03/07		1.7	1	0
03/08		1.4	0	0
03/09		1.7	2	0
03/10		1.8	1	0
03/11		1.7	2	2
03/12		2.3	1	0
03/13		2.5	0	0
03/14		2.2	1	0
03/15		1.9	2	0
03/16		2.3	2	0
03/17		2.3	2	1
03/18		2.6	0	0
03/19		2.3	1	0
03/20		2.1	0	0
03/21		1.9	1	0
03/22		2.1	1	1
03/23		2.4	1	0
03/24		2.4	1	0
03/25		2.4	1	0
03/26		2.5	1	0
03/27		2.7	0	0
03/28		2.8	0	0
03/29		2.8	1	0
03/30	6.80	3.1	3	0
04/01		3.4	2	0
04/02		4.0	2	0
04/03		3.6	1	0
04/04		3.9	0	0
04/05		3.9	1	0
04/06		3.8	1	0
04/07		4.1	1	0
04/08		4.4	1	0
04/09		4.1	2	0
04/10		4.5	2	0
04/11		4.7	2	0
04/12		5.1	1	0
04/13		5.7	3	0
04/14		5.3	1	0
04/15		5.4	1	0
04/16		6.0	1	0
04/17		6.1	0	0

QUABBIN LABORATORY RECORDS 2006
M.W.R.A. WINSOR DISINFECTION STATION

DATE		WDFR			
		pH	**TEMPC**	**TOTCOLI**	**FECCOLI**
04/18			6.0	5	0
04/19			6.6	1	0
04/20			6.6	1	0
04/21			6.7	2	0
04/22			7.1	1	0
04/23			7.3	2	0
04/24			6.9	0	0
04/25			7.4	2	0
04/26			7.8	7	0
04/27			6.5	3	1
04/28			8.7	0	0
04/29			8.5	2	0
05/01		6.60	9.0	0	0
05/02		6.30	9.5	4	0
05/03		6.60	9.1	1	0
05/04		6.40	9.3	3	0
05/05		6.50	8.6	3	0
05/06		6.50	8.2	2	0
05/07		6.40	9.0	12	0
05/08		6.90	8.8	0	0
05/09		6.40	8.7	5	0
05/10		6.50	11.0	2	0
05/11		6.70	10.4	3	0
05/12		6.60	8.7	1	0
05/13		6.60	10.5	4	0
05/14		6.30	11.1	9	0
05/15		7.10	11.8	1	0
05/16		6.80	10.7	6	0
05/17		6.50	10.1	5	0
05/18		6.70	9.6	1	0
05/19		6.50	9.6	3	0
05/20		6.40	9.5	5	0
05/21		6.40	9.3	3	0
05/22		6.80	10.6	0	0
05/23		6.50	10.7	5	0
05/24		6.30	10.3	4	0
05/25		6.70	10.4	3	0
05/26		6.40	9.8	1	0
05/27		6.40	9.7	4	0
05/28		6.50	11.7	4	0
05/29		6.40	9.9	1	0
05/30		6.60	10.1	0	0
06/01		6.50	10.2	2	0
06/02		6.60	12.0	2	0
06/03		6.50	10.6	2	0
06/04		6.40	10.9	8	0
06/05		7.60	10.2	0	0
06/06		6.50	10.5	2	0
06/07		6.30	10.9	3	0
06/08		6.80	10.9	8	0
06/09		6.50	10.2	6	0
06/10		6.50	10.6	6	0
06/11		6.50	10.8	14	0

QUABBIN LABORATORY RECORDS 2006
M.W.R.A. WINSOR DISINFECTION STATION

DATE		WDFR			
		pH	**TEMPC**	**TOTCOLI**	**FECCOLI**
06/12		6.40	10.4	0	0
06/13		7.10	10.3	4	0
06/14		6.50	10.6	5	0
06/15		7.10	11.0	8	0
06/16		6.70	11.6	5	0
06/17		6.50	10.6	4	0
06/18		6.60	10.9	8	0
06/19		6.60	10.8	0	0
06/20		7.20	11.1	5	0
06/21		6.60	10.8	4	0
06/22		7.10	10.8	5	0
06/23		6.60	11.1	3	0
06/24		6.60	11.1	4	0
06/25		6.50	10.8	4	0
06/26		6.60	11.3	0	0
06/27		6.40	11.0	5	0
06/28		6.60	11.4	4	0
06/29		6.80	11.1	5	0
07/01		6.50	11.0	2	0
07/02		6.50	11.1	3	0
07/03		6.60	11.4	4	1
07/04		6.50	10.6	3	0
07/05		7.40	11.6	4	0
07/06		7.40	11.3	0	0
07/07		6.60	11.4	2	0
07/08		6.50	11.3	2	0
07/09		6.50	11.2	3	0
07/10		6.40	11.2	6	0
07/11		6.40	11.0	3	0
07/12		6.40	11.3	2	0
07/13		7.00	11.3	2	0
07/14		6.60	11.5	1	0
07/15		6.60	11.5	4	0
07/16		6.60	11.5	5	0
07/17		6.60	11.4	0	0
07/18		7.40	11.8	2	0
07/19		6.50	11.3	1	0
07/20		6.80	16.8	4	0
07/21		6.50	11.1	4	0
07/22		6.50	11.7	6	0
07/23		6.40	11.3	2	0
07/24		6.50	11.3	2	0
07/25		7.40	11.7	2	0
07/26		6.60	11.8	3	0
07/27		6.30	11.8	2	0
07/28		6.60	11.7	1	0
07/29		6.50	16.7	4	0
07/30		6.50	11.7	2	0
07/31		6.50	12.0	2	1
08/01		7.50	12.1	0	1
08/02		6.40	11.9	0	0
08/03		6.70	11.7	7	1
08/04		6.50	12.1	0	0

QUABBIN LABORATORY RECORDS 2006
M.W.R.A. WINSOR DISINFECTION STATION

DATE		WDFR			
		pH	**TEMPC**	**TOTCOLI**	**FECCOLI**
08/05		6.50	12.3	2	1
08/06		6.40	11.7	2	0
08/07		6.60	11.9	2	0
08/08		7.00	12.4	0	0
08/09		6.40	11.7	2	0
08/10		7.00	13.8	0	0
08/11		6.50	12.9	4	0
08/12		6.40	12.1	0	0
08/13		6.50	12.1	3	0
08/14		6.50	12.3	0	0
08/15		7.30	12.5	0	0
08/16		6.40	12.4	0	0
08/17		7.20	12.8	1	0
08/18		6.50	12.3	0	0
08/19		6.40	12.3	3	0
08/20		6.50	11.9	0	0
08/21		6.40	12.7	0	0
08/22		7.00	12.4	1	0
08/23		6.40	12.4	1	0
08/24		6.70	12.5	2	0
08/25		6.40	12.5	3	0
08/26		6.40	12.6	2	0
08/27		6.40	12.1	2	0
08/28		6.40	12.7	0	0
08/29		6.90	12.6	2	0
08/30		6.40	12.5	0	0
08/31		6.90	13.1	1	0
09/01		6.40	12.5	2	0
09/02		6.40	12.8	2	0
09/03		6.30	13.3	2	0
09/04		6.30	12.6	0	0
09/05		6.90	12.7	7	0
09/06		6.40	12.4	0	0
09/07		7.00	12.9	3	0
09/08		6.40	12.5	1	0
09/09		6.30	12.5	8	0
09/10		6.30	13.3	6	0
09/11		6.20	12.7	0	0
09/12		6.60	13.0	2	0
09/13		6.30	12.9	8	0
09/14		6.70	13.0	6	0
09/15		6.40	13.3	2	0
09/16		6.40	13.2	8	0
09/17		6.30	13.3	3	0
09/18		6.40	12.8	0	0
09/19		7.00	13.2	2	1
09/20		6.40	14.0	8	0
09/21		6.80	13.3	1	0
09/22		6.30	12.6	3	0
09/23		6.30	12.7	3	0
09/24		6.40	13.8	2	0
09/25		6.40	13.5	4	0
09/26		6.60	13.3	5	0

QUABBIN LABORATORY RECORDS 2006
M.W.R.A. WINSOR DISINFECTION STATION

DATE		WDFR			
		pH	**TEMPC**	**TOTCOLI**	**FECCOLI**
09/27		6.30	13.8	19	0
09/28		6.80	14.0	5	0
09/29		6.30	13.8	4	0
09/30		6.20	13.5	29	0
10/01		6.20	12.9	3	0
10/02		6.30	14.6	3	0
10/03		6.60	13.0	4	0
10/04		6.20	13.3	4	0
10/05		6.80	18.0	20	6
10/06		6.60	17.7	24	1
10/07		6.70	17.7	4	0
10/08		6.50	15.8	7	1
10/09		6.20	13.7	0	0
10/10		6.60	15.6	7	0
10/11		6.30	15.5	0	0
10/12		6.80	17.1	10	0
10/13		6.50	16.4	9	1
10/14		6.20	13.8	7	0
10/15		6.20	13.9	3	1
10/16		6.40	15.3	2	1
10/17		6.70	15.0	2	0
10/18		6.20	13.8	5	0
10/19		6.60	15.2	3	1
10/20		6.20	13.9	20	1
10/21		6.60	15.3	16	3
10/22		6.60	15.3	4	2
10/23		6.40	14.4	4	0
10/24		6.90	14.9	5	0
10/25		6.60	14.5	17	1
10/26		6.70	14.1	10	2
10/27		6.50	13.8	2	1
10/28		6.40	13.5	12	1
10/29		6.30	13.0	6	2
10/30		6.50	12.9	4	1
10/31		6.60	13.8	10	0
11/01		6.40	12.7	21	1
11/02		6.80	13.2	5	1
11/03		6.50	12.6	16	0
11/04		6.40	12.5	4	1
11/05		6.40	12.1	11	1
11/06		6.50	12.0	7	0
11/07		6.40	12.0	6	1
11/08		6.40	11.9	8	0
11/09		6.60	12.2	29	1
11/10		6.40	12.1	75	0
11/11		6.50	12.1	8	2
11/12		6.50	12.0	9	0
11/13		6.50	12.1	10	1
11/14		6.70	12.3	30	1
11/15		6.40	12.1	12	2
11/16		6.20	12.2	2	1
11/17		6.20	11.5	68	1
11/18		6.40	11.9	20	1

QUABBIN LABORATORY RECORDS 2006
M.W.R.A. WINSOR DISINFECTION STATION

DATE	WDFR			
	pH	**TEMPC**	**TOTCOLI**	**FECCOLI**
11/19	6.30	11.7	21	1
11/20	6.40	11.8	28	1
11/21	6.30	11.6	7	1
11/22	7.10	11.2	70	0
11/23	6.40	11.1	5	0
11/24	6.50	10.9	21	1
11/25	6.40	10.8	11	0
11/26	6.50	10.7	63	1
11/27	6.60	10.6	4	1
11/28	6.40	11.9	12	0
11/29	6.50	10.6	16	0
11/30	7.00	10.5	34	0
12/01	6.50	10.5	29	0
12/02	6.50	10.5	72	1
12/03	6.60	10.3	83	0
12/04	6.50	10.2	12	0
12/05	6.20	9.9	28	1
12/06	6.50	9.7	12	0
12/07	6.70	9.8	22	0
12/08	6.50	9.5	13	0
12/09	6.60	9.2	34	0
12/10	6.60	9.0	26	0
12/11	6.60	9.0	0	0
12/12	7.00	8.7	41	0
12/13	6.60	8.9	18	0
12/14	7.00	8.8	32	0
12/15	6.60	8.9	50	0
12/16	6.60	8.8	48	1
12/17	6.60	8.8	42	0
12/18	6.60	8.7	0	0
12/19	6.80	9.4	27	2
12/20	6.60	8.3	27	1
12/21	7.00	8.1	14	1
12/22	6.60	8.2	13	0
12/23	6.60	8.2	12	1
12/24	6.50	8.1	2	0
12/25	6.60	8.0	5	0
12/26	6.70	7.8	6	0
12/27	6.80	7.9	10	1
12/28	7.00	8.0	6	1
12/29	6.60	7.8	8	0
12/30	6.60	7.7	9	0
12/31	6.60	7.5	4	1
AVG.	6.6	9.1	7	0
MAX.	7.6	18.0	83	6
MIN.	6.2	1.4	0	0
MEDIAN	6.5	10.6	3	0

QUABBIN LABORATORY RECORDS 2006
DRINKING WATER WELL SAMPLES

02/21/06 Samples collected and sent to MHW Laboratories, analysis was performed for Synthetic Organic Contaminants.
Location - Admin Fountain
All compounds were below detection limits, trip blank sample clean.

05/08/06 Sample collected and sent to MWRA Deer Island Laboratory, analysis was performed for Nitrate and Nitrite.
Location - Admin Fountain
Nitrate - 0.151 mg/L
Nitrite - Below Detection Limit

08/15/06 Samples collected and sent to MWRA Deer Island Laboratory, analysis was performed for Volatile Organic Contaminants.
Location - Admin. Bldg. Fountain
All compounds were below detection limits, trip blank sample clean.

09/25/06 Samples collected and sent to MWRA Deer Island Laboratory, analysis was performed for Lead and Copper.

Location	Type	Lead	Copper
Admin Bldg - Kitchen	First Draw	0.004 mg/L	0.0611 mg/L
Admin Bldg - Kitchen	2-Min. Flush	<0.0012 mg/L	0.0519 mg/L
Admin Bldg - Kitchen	POU Filter	<0.0012 mg/L	0.00393 mg/L
Residence #1	First Draw	0.00359 mg/L	0.373 mg/L
Residence #1	2-Min. Flush	<0.0012 mg/L	0.0473 mg/L
Residence #2	First Draw	<0.0012 mg/L	0.0166 mg/L
Residence #2	2-Min. Flush	<0.0012 mg/L	0.00745 mg/L
Residence #3	First Draw	0.00556 mg/L	2.42 mg/L
Residence #3	2-Min. Flush	<0.0012 mg/L	1.54 mg/L
Residence #3	POU Filter	<0.0012 mg/L	<0.003 mg/L
New Salem Office	First Draw	0.00594 mg/L	0.277 mg/L
New Salem Office	2-Min. Flush	0.00384 mg/L	0.0769 mg/L

08/03/06 Samples collected from Comet Pond Beach and analyzed for Fecal Coliform bacteria and E. coli bacteria.
Location - Comet Pond Beach, Hubbardston

	Ecoli (MPN/100mL)	Fecal Coliform (CFU/100mL)
Beach Left	10	76
Beach Middle	20	14
Beach Right	0	4

ADMINISTRATION BUILDING BACTERIOLOGICAL ANALYSIS RESULTS

	Total Coilform (CFU/100mL)				E. coli (MPN/100mL)
Date	Admin. Bldg. Fountain	Visitor Center Fountain	Kitchen Tap	Sink (2nd Floor)	Kitchen Tap
1/5/2006	A	A	----	----	----
2/6/2006	A	A	----	----	----
3/6/2006	A	A	----	----	----
4/3/2006	A	A	----	----	----
5/1/2006	A	A	----	----	----
6/5/2006	A	A	----	----	----
7/10/2006	A	A	----	----	----
8/7/2006	A	A	----	----	----
9/11/2006	A	A	----	----	----
10/2/2006	A	----	----	----	----
10/16/2006	----	----	**P**	----	A
10/17/2006	A	----	A	A	----
10/23/2006	----	----	A	----	----
11/6/2006	A	----	A	----	----
11/20/2006	A	----	----	A	----
11/22/2006	----	A	----	----	----
12/4/2006	A	A	----	----	----
Note: P – Present A - Absent					

QUABBIN LABORATORY RECORDS 2006
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
04-20	0.0	0.2	10.1		4.6	2.9					0	0	529.66
04-20	1			6.98			15.02	124	6.2	47			
04-20	3			6.89			14.95	123	6.2	47			
04-20	6			6.83			14.81	122	6.2	47			
04-20	9			6.81			14.71	121	6.1	47			
04-20	12			6.74			14.66	121	6.0	47			
04-20	15			6.71			14.66	121	6.0	47			
04-20	18			6.71			14.55	120	6.0	47	0	0	
04-20	21			6.68			14.51	119	6.0	47			
04-20	24			6.68			14.37	118	6.0	47			
04-20	27			6.66			14.33	118	5.9	47			
04-20	30			6.63			14.35	118	5.9	47			
04-20	33			6.61			14.43	118	5.8	47			
04-20	36			6.6			14.4	118	5.8	47			
04-20	39			6.59			14.34	117	5.8	47			
04-20	40			6.57			14.33	117	5.8	47			
04-20	41			6.59			14.14	116	5.8	47			
05/17	0.5	0.20	10.2	6.98	4.9	2.8	12.32	116	11.0	45	0	0	529.74
05/17	1			6.94			12.19	114	11.0	45			
05/17	3			6.91			11.96	112	10.9	45			
05/17	6			6.86			11.95	111	10.7	45			
05/17	9			6.81			11.91	111	10.6	45			
05/17	12			6.76			11.84	110	10.6	45			
05/17	15			6.77			11.95	110	10.2	45			
05/17	18			6.75			12.92	112	7.8	45	0	0	
05/17	21			6.66			13.22	114	7.5	45			
05/17	24			6.6			13.12	113	7.4	45			
05/17	27			6.54			13.2	113	7.2	45			
05/17	30			6.5			13.16	112	7.0	45			
05/17	33			6.49			13.35	113	6.8	45			
05/17	36			6.45			13.17	111	6.4	45			
05/17	39	0.20		6.41	4.9	2.7	13.17	110	6.3	45			
05/17	40			6.33			12.8	107	6.1	45			
06/21	0.5		8.7	6.95			10.41	115	19.2	45	0	0	529.88
06/21	1			6.95			10.34	114	19.1	45			
06/21	2			6.94			10.13	111	19.0	45			
06/21	3			6.93			10.19	112	18.9	45			
06/21	4			6.92			10.33	112	18.5	45			
06/21	5			6.93			10.6	113	17.6	45			
06/21	6			6.93			10.7	114	17.4	45	0	0	
06/21	7			6.93			10.82	114	17.2	45			
06/21	8			6.94			10.95	114	16.7	45			
06/21	9			6.95			10.99	114	16.1	45			
06/21	10	0.29		6.94	6.13	3.34	11.16	114	15.5	45			
06/21	11			6.94			11.64	116	14.5	45			

QUABBIN LABORATORY RECORDS 2006
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
06/21	12.0			6.96			12.67	120	12.2	45			
06/21	13.0			6.94			12.88	121	11.7	45			
06/21	14.0			6.92			12.91	120	11.4	45			
06/21	15.1			6.91			12.9	118	10.7	45			
06/21	16.0			6.86			12.88	117	10.4	45			
06/21	17.0			6.8			12.57	114	10.1	45			
06/21	18.0			6.76			12.71	114	10.0	45	0	0	
06/21	19.0			6.71			12.45	112	9.9	45			
06/21	20.0			6.67			12.68	113	9.7	45			
06/21	21.0			6.63			12.71	114	9.6	45			
06/21	22.1			6.6			12.52	111	9.5	45			
06/21	23.0			6.56			12.5	111.4	9.43	45			
06/21	24.0			6.53			12.64	112	9.2	45			
06/21	25.0			6.48			12.57	111	9.0	45			
06/21	26.1			6.43			12.38	109	8.9	45			
06/21	27.0			6.4			12.44	109	8.8	45			
06/21	28.1			6.38			12.53	109	8.7	45			
06/21	29.0			6.34			12.42	108	8.5	45			
06/21	30.0	0.20		6.32	6.11	3.16	12.51	108	8.3	45			
06/21	31.1			6.3			12.77	110	8.2	45			
06/21	32.0			6.28			12.56	108	8.0	45			
06/21	33.0			6.27			12.86	110	7.8	45			
06/21	34.0			6.24			12.74	109	7.7	45			
06/21	35.0			6.21			12.8	109	7.5	45			
06/21	36.0			6.18			12.55	106	7.4	45			
06/21	37.0			6.16			12.33	104	7.4	45			
06/21	38.0			6.13			12.27	104	7.3	45			
06/21	39.0			6.11			12.26	104	7.3	45			
06/21	40.0			6.1			12.42	105	7.3	45			
06/21	41.0			6.08			12.17	103	7.2	46			
07/26	0.5		12.6	6.76			8.97	108	23.7	46	0	0	529.44
07/26	1.0			6.74			8.81	106	23.7	46			
07/26	2.0			6.72			8.81	106	23.4	46			
07/26	3.1			6.7			8.79	105	23.4	46			
07/26	4.0	0.21		6.68	4.7	2.7	8.83	105	23.3	46			
07/26	5.0			6.66			9.3	109	22.4	46			
07/26	6.0			6.65			9.55	111	21.7	46	0	0	
07/26	7.0			6.62			9.76	111	20.8	46			
07/26	8.0			6.62			10.19	113	19.6	46			
07/26	9.0			6.61			10.26	113	19.2	46			
07/26	10.0			6.64			10.97	115	16.8	46			
07/26	11.1			6.64			11.02	114	15.9	46			
07/26	12.0			6.63			11.32	113	14.4	46			
07/26	13.0			6.64			11.74	114	13.3	46			
07/26	14.1			6.63			11.95	113	12.1	46			

QUABBIN LABORATORY RECORDS 2006
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
07/26	15.0			6.6			11.8	111	11.7	46			
07/26	16.0			6.57			11.64	109	11.5	46			
07/26	17.0			6.48			11.44	106	11.0	46			
07/26	18.0			6.43			11.24	103	10.7	46	0	0	
07/26	19.0			6.38			11.15	102	10.6	46			
07/26	20.0			6.31			10.99	100	10.4	46			
07/26	21.0			6.26			10.91	99	10.2	46			
07/26	22.0			6.23			10.89	99	10.2	46			
07/26	23.0			6.22			10.87	98	10.1	46			
07/26	24.0			6.18			10.81	97	9.9	46			
07/26	25.0			6.14			10.67	96	9.7	46			
07/26	26.0			6.13			10.66	95	9.6	46			
07/26	27.0			6.1			10.61	94	9.3	46			
07/26	28.0	0.17		6.07	4.9	2.9	10.6	94	9.2	46			
07/26	29.0			6.05			10.56	93	9.1	46			
07/26	30.0			6.02			10.87	95	8.8	46			
07/26	31.0			6			10.51	92	8.5	46			
07/26	32.0			5.98			10.4	90	8.4	46			
07/26	33.0			5.95			10.3	89	8.4	46			
07/26	34.0			5.92			10.18	88	8.3	46			
07/26	35.0			5.89			10.12	87	8.2	46			
07/26	36.0			5.87			10.07	87	8.1	46			
07/26	37.0			5.86			9.98	86	8.0	46			
07/26	38.0			5.84			9.94	85	7.9	46			
07/26	39.0			5.83			9.84	84	7.9	46			
08/16	0.5		11.3	6.61			8.89	107	23.7	46	0	0	528.38
08/16	1.0			6.6			8.75	105	23.7	46			
08/16	2.0			6.59			8.63	104	23.7	46			
08/16	3.0			6.58			8.63	104	23.7	46			
08/16	4.0			6.59			8.59	103	23.7	46			
08/16	5.0			6.58			8.5	102	23.7	46			
08/16	6.0			6.58			8.45	102	23.7	46	0	0	
08/16	7.0			6.57			8.54	102	23.4	46			
08/16	8.0			6.57			8.85	104	22.7	46			
08/16	9.0			6.56			9.27	108	21.9	46			
08/16	10.0			6.52			10.52	115	18.6	46			
08/16	11.0			6.54			11.43	118	15.9	46			
08/16	12.1			6.52			11.54	116	14.8	46			
08/16	13.0			6.53			11.72	115	13.8	46			
08/16	14.0			6.51			11.66	112	12.9	46			
08/16	15.0			6.44			11.3	108	12.3	46			
08/16	16.1			6.32			11.15	105	11.7	46			
08/16	17.1			6.27			10.95	102	11.3	46			
08/16	18.1	0.23		6.2	4.4	2.5	10.83	100	10.9	46	0	0	
08/16	19.0			6.15			10.72	98	10.8	46			

QUABBIN LABORATORY RECORDS 2006
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
08/16	20.0			6.08			10.57	97	10.6	46			
08/16	21.1			6.02			10.47	96	10.5	46			
08/16	22.1			6			10.36	94	10.3	46			
08/16	23.0			5.95			10.27	93	10.2	46			
08/16	24.1			5.93			10.15	92	10.0	46			
08/16	25.0			5.92			10.12	91	9.9	46			
08/16	26.0			5.91			10.1	90	9.7	46			
08/16	27.1			5.88			9.95	89	9.5	46			
08/16	28.1			5.87			9.89	88	9.3	46			
08/16	29.1			5.85			9.89	87	9.0	46			
08/16	30.0			5.83			9.75	85	8.8	46			
08/16	31.0			5.79			9.53	83	8.6	46			
08/16	32.1			5.77			9.42	82	8.5	47			
08/16	33.0			5.75			9.39	82	8.5	47			
08/16	34.0			5.73			9.27	80	8.4	47			
08/16	35.0			5.72			9.15	79	8.3	47			
08/16	36.0			5.69			9.06	78	8.3	47			
08/16	37.1			5.67			8.92	77	8.2	47			
08/16	38.1			5.67			8.84	76	8.2	47			
08/16	39.0			5.66			8.77	76	8.1	47			
08/16	40.0	0.20		5.64	4.4	2.6	8.58	74	8.1	47			
08/16	41.0			5.63			8.51	73	8.1	47			
09/21	0.5		11.4								0	0	527.04
09/21	1.0			6.65			9.81	110	19.9	46			
09/21	2.0			6.66			9.77	109	19.8	46			
09/21	3.0			6.66			9.73	109	19.9	46			
09/21	4.1			6.67			9.68	108	19.9	46			
09/21	5.0			6.65			9.59	107	19.9	46			
09/21	6.0			6.65			9.56	107	19.9	46	0	0	
09/21	7.0			6.65			9.51	106	19.9	46			
09/21	8.0			6.65			9.54	107	19.9	46			
09/21	9.1			6.65			9.48	106	19.9	46			
09/21	10.1			6.65			9.47	106	19.9	46			
09/21	11.1			6.65			9.47	106	19.9	46			
09/21	12.1			6.65			9.48	106	19.9	46			
09/21	13.0			6.64			10.56	112	17.2	46			
09/21	14.0			6.58			11.53	116	14.6	45			
09/21	15.0	0.31		6.49	6.7	3.1	11.66	114	13.6	46			
09/21	16.0			6.41			11.5	111	12.7	46			
09/21	17.0			6.31			11.15	106	12.1	46			
09/21	18.0			6.24			10.88	102	11.7	46	0	1	
09/21	19.0			6.12			10.54	98	11.4	46			
09/21	20.1			6.08			10.51	98	11.2	46			
09/21	21.0			6.06			10.46	97	11.0	46			
09/21	22.1			6.03			10.46	96	10.7	46			

QUABBIN LABORATORY RECORDS 2006
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
09/21	23.0			5.96			10.25	94	10.6	46			
09/21	24.1			5.92			10.06	92	10.4	46			
09/21	25.0			5.91			10.06	91	10.3	46			
09/21	26.0			5.87			9.85	89	10.0	46			
09/21	27.0	0.18		5.85	6.6	3.0	9.88	89	9.9	46			
09/21	28.1			5.82			9.64	87	9.7	46			
09/21	29.1			5.8			9.57	85	9.4	46			
09/21	30.0			5.77			9.32	83	9.3	46			
09/21	30.9			5.76			9.35	83	9.1	46			
09/21	32.0			5.74			9.17	81	8.9	46			
09/21	33.1			5.72			9.08	80	8.8	46			
09/21	34.0			5.71			9.11	80	8.7	46			
09/21	35.0			5.7			8.95	78	8.5	46			
09/21	36.1			5.67			8.63	75	8.5	46			
09/21	37.0			5.64			8.53	74	8.4	46			
09/21	38.1			5.63			8.21	71	8.3	46			
09/21	39.0			5.56			7.38	64	8.2	47			
09/21	40.0			5.55			7.33	63	8.2	47			
09/21	41.1			5.53			7.07	61	8.2	47			
10/19	0.5	0.28	10.8	6.74	4.9	2.7	9.51	96	15.5	46	10	0	526.35
10/19	1.0			6.71			9.53	96	15.5	46			
10/19	2.0			6.67			9.65	98	15.5	46			
10/19	3.1			6.65			9.6	97	15.5	46			
10/19	4.0			6.62			9.64	97	15.5	46			
10/19	5.0			6.6			9.61	97	15.5	46			
10/19	6.1			6.57			9.53	96	15.5	46			
10/19	7.0			6.55			9.52	96	15.5	46			
10/19	8.0			6.53			9.47	96	15.5	46			
10/19	9.0			6.51			9.5	96	15.5	46			
10/19	10.0			6.48			9.5	96	15.5	46			
10/19	11.1			6.47			9.44	95	15.5	46			
10/19	12.0			6.47			9.42	95	15.5	46			
10/19	13.1			6.46			9.4	95	15.5	46			
10/19	14.0			6.44			9.41	95	15.4	46			
10/19	15.0			6.42			9.35	94	15.4	46			
10/19	16.1			6.37			9.24	93	15.2	46			
10/19	17.0			6.26			9.17	88	13.1	46			
10/19	18.0	0.25		6.1	4.5	3.2	9.07	86	12.4	46	0	0	
10/19	19.0			6.01			8.96	84	11.9	46			
10/19	20.0			5.92			8.91	83	11.6	46			
10/19	21.0			5.87			8.81	81	11.4	46			
10/19	22.1			5.82			8.76	81	11.2	46			
10/19	23.0			5.78			8.76	80	11.1	46			
10/19	24.0			5.75			8.72	80	11.0	46			
10/19	25.1			5.75			8.85	81	10.8	46			

QUABBIN LABORATORY RECORDS 2006
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
10/19	26.0			5.73			8.76	79	10.6	46			
10/19	27.0			5.72			8.67	78	10.4	46			
10/19	28.0			5.71			8.53	77	10.2	46			
10/19	29.1			5.69			8.58	77	10.0	46			
10/19	30.0			5.68			8.38	75	9.8	47			
10/19	31.1			5.66			8.24	73	9.6	47			
10/19	32.0			5.64			8.13	72	9.3	47			
10/19	33.1			5.62			7.98	70	9.1	47			
10/19	34.1			5.62			7.83	68	9.0	47			
10/19	35.0			5.59			7.68	67	8.8	47			
10/19	36.0			5.56			7.36	64	8.7	47			
10/19	37.0			5.54			7.09	61	8.6	47			
10/19	38.0			5.51			6.83	59	8.6	47			
10/19	39.1	0.18		5.51	4.3	2.5	6.67	58	8.5	47	0	0	
11/15	0.5	0.28	11.0	6.63	5.4	3.0	11.35	108	11.8	46	0	0	527.04
11/15	1.0			6.56			11.28	107	11.8	46			
11/15	2.0			6.49			11.06	105	11.8	46			
11/15	3.0			6.46			10.95	104	11.8	46			
11/15	4.0			6.42			10.97	104	11.8	46			
11/15	5.0			6.4			10.89	103	11.8	46			
11/15	6.0			6.36			10.8	102	11.8	46			
11/15	7.0			6.34			10.91	103	11.8	46			
11/15	8.0			6.32			10.87	103	11.8	46			
11/15	9.0			6.31			10.8	102	11.7	46			
11/15	10.0			6.29			10.66	101	11.7	46			
11/15	11.0			6.28			10.74	102	11.7	46			
11/15	12.0			6.27			10.72	102	11.7	46			
11/15	13.0			6.26			10.62	101	11.7	46			
11/15	14.0			6.25			10.55	100	11.7	46			
11/15	15.0			6.25			10.55	100	11.7	46			
11/15	16.0			6.24			10.55	100	11.7	46			
11/15	17.0			6.23			10.51	100	11.7	46			
11/15	18.0			6.22			10.49	99	11.7	46	0	0	
11/15	19.0			6.21			10.48	99	11.7	46			
11/15	20.0			6.21			10.50	99	11.7	46			
11/15	21.0			6.20			10.40	98	11.7	46			
11/15	22.0			6.19			10.49	99	11.64	46			
11/15	23.0			6.18			10.33	98	11.61	46			
11/15	24.0			6.18			10.40	98	11.58	46			
11/15	25.0			6.15			10.25	97	11.50	46			
11/15	26.0			6.13			10.12	95	11.44	46			
11/15	27.0			6.10			10.11	95	11.43	46			
11/15	28.0			6.09			10.03	94	11.41	46			
11/15	29.0			6.08			9.93	93	11.35	46			
11/15	30.0			6.02			9.41	88	10.99	46			

QUABBIN LABORATORY RECORDS 2006
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
11/15	31.0			5.88			8.45	77	10.34	46			
11/15	32.0			5.78			7.88	72	10.06	47			
11/15	33.0			5.70			7.21	65	9.57	47			
11/15	34.0			5.65			6.98	63	9.34	47			
11/15	35.0			5.62			6.77	61	9.27	47			
11/15	36.0			5.58			6.66	59	9.24	47			
11/15	37.0			5.58			6.57	59	9.21	47			
11/15	38.0			5.56			6.52	58	9.21	47			
11/15	39.0	0.19		5.56	5.3	3.2	6.54	58	9.19	47	10	0	
11/15	40.0			5.56			6.62	59	9.14	47			
12/14	0.5	0.25	10.6	6.53	5.5	3.0	12.05	104	8.46	46	0	0	527.7
12/14	1.0			6.47			11.92	103	8.47	46			
12/14	3.0			6.40			11.85	102	8.46	46			
12/14	6.0			6.32			11.78	101	8.46	46	0	0	
12/14	9.0			6.29			11.78	101	8.46	46			
12/14	12.0			6.27			11.79	101	8.45	46			
12/14	15.0			6.21			11.66	100	8.45	46			
12/14	18.0			6.20			11.58	100	8.46	46	0	0	
12/14	20.1	0.37		6.20	5.4	2.8	11.60	100	8.46	46			
12/14	21.1			6.20			11.49	99	8.45	46			
12/14	24.1			6.20			11.54	99	8.45	46			
12/14	27.0			6.20			11.55	99	8.46	46			
12/14	30.0			6.20			11.52	99	8.45	46			
12/14	33.1			6.20			11.43	98	8.46	46			
12/14	36.0			6.20			11.39	98	8.45	46			
12/14	39.0	0.25		6.20	5.5	3.0	11.52	99	8.39	46			
	AVG.	**0.23**	**10.7**	**6.29**	**5.21**	**2.89**	**10.54**	**98**	**11.68**	**46**	**<10**	**<1**	
	MAX.	**0.37**	**12.6**	**6.98**	**6.71**	**3.34**	**15.02**	**124**	**23.69**	**47**	**10**	**1**	
	MIN.	**0.17**	**8.7**	**5.51**	**4.33**	**2.47**	**6.52**	**58**	**5.80**	**45**	**0**	**0**	
	MEDIAN	**0.22**	**10.8**	**6.31**	**4.92**	**2.90**	**10.49**	**101**	**10.40**	**46**	**0**	**0**	

QUABBIN LABORATORY RECORDS 2006
(206) SHAFT #12 --- RESERVOIR

DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
04/20	0.0	0.24	8.3		5.1	3.5					0	0	530.25
04/20	1.0			7.73			15.09	126	6.5	47			
04/20	3.0			7.54			14.61	121	6.4	47			
04/20	6.0			7.39			14.44	120	6.3	47	0	0	
04/20	9.1			7.31			14.35	119	6.2	47			
04/20	12.1			7.22			14.37	119	6.2	47			
04/20	15.0			7.13			14.45	119	6.2	47			
04/20	18.0			7.06			14.28	118	6.2	47			
04/20	21.0			7.01			14.36	119	6.2	47			
04/20	24.1			6.95			14.29	118	6.2	47	0	0	
04/20	27.0			6.91			14.09	116	6.1	47			
04/20	30.0			6.87			14.32	118	6.0	47			
04/20	31.0			6.84			14.12	116	6.03	47			
04/20	32.0			6.83			14.09	116	6.0	47			
04/20	33.1	0.24		6.81	4.7	3.0	14.32	118	6.0	47			
04/20	34.0			6.78			14.12	116	6.0	47			
05/17	0.5	0.18	10.1	6.8	4.9	2.9	12.74	117	10.2	45	0	0	529.74
05/17	1.0			6.78			12.63	116	10.3	45			
05/17	3.1			6.75			12.5	115	10.2	45			
05/17	6.0			6.73			12.52	115	10.0	45			
05/17	9.0			6.71			12.51	114	9.9	45			
05/17	12.0			6.69			12.29	112	9.9	45			
05/17	15.0			6.68			12.26	112	9.9	45			
05/17	18.0			6.66			12.3	112	9.8	45			
05/17	21.1			6.62			12.97	115	8.5	45			
05/17	24.1			6.55			12.78	112	8.1	45	0	0	
05/17	27.0	0.18		6.5	4.9	2.9	13.09	113	7.7	45			
06/21	0.5		9.1	7.05			9.63	109	20.6	45	0	0	529.88
06/21	1.1			7.06			9.7	109	20.3	45			
06/21	2.0			7.06			10	111	19.6	45			
06/21	3.1			7.06			10.04	110	19.1	45			
06/21	4.0			7.06			10.21	110	18.2	45			
06/21	5.0			7.04			10.25	110	17.9	45			
06/21	6.0			7.04			10.49	110	17.0	45	0	0	
06/21	7.0			7.03			10.59	111	16.7	45			
06/21	8.1			7.02			10.9	112	15.8	45			
06/21	9.0	0.30		7.03	6.0	3.2	11.15	111	14.6	45			
06/21	10.1			7.02			11.41	112	13.9	45			
06/21	11.1			7.02			11.87	115	13.2	45			
06/21	12.1			7.01			11.95	114	12.3	45			
06/21	13.0			6.95			11.97	113	11.9	45			
06/21	14.1			6.93			12.14	113	11.6	45			
06/21	15.0			6.88			12.18	113	11.2	45			

QUABBIN LABORATORY RECORDS 2006
(206) SHAFT #12 --- RESERVOIR

DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
06/21	16.1			6.84			12.17	112	10.7	45			
06/21	17.0			6.78			12.21	112	10.6	45			
06/21	18.0			6.77			12.19	110	10.2	45			
06/21	19.0			6.71			12.18	110	10.0	45			
06/21	20.0			6.66			11.96	107	9.7	45			
06/21	21.0			6.62			11.9	106	9.6	46			
06/21	22.0			6.53			11.74	104	9.3	46			
06/21	23.0			6.47			11.65	103	9.2	46			
06/21	24.1	0.20		6.44	6.1	3.2	11.8	104	9.1	46	0	0	
06/21	25.0			6.41			11.87	105	9.0	46			
06/21	26.0			6.37			11.85	104	8.9	46			
06/21	27.0			6.33			11.65	102	8.7	46			
06/21	28.0			6.28			11.75	102	8.5	46			
06/21	29.1			6.24			11.76	102	8.3	46			
06/21	30.0			6.19			11.68	100	8.0	46			
06/21	31.0			6.16			11.69	100	7.8	46			
06/21	32.1			6.13			11.52	98	7.5	46			
06/21	33.0			6.12			11.69	98	7.2	46			
06/21	34.0			6.09			11.81	99	7.1	46			
06/21	35.0			6.06			11.59	97	7.0	46			
06/21	36.0			6.02			11.22	94	6.9	46			
07/26	0.5		12.2	6.71			8.32	102	25.0	46	0	0	529.44
07/26	1.0			6.71			8.23	101	24.9	46			
07/26	2.0			6.71			8.35	102	24.7	46			
07/26	3.0			6.7			8.31	102	24.7	46			
07/26	4.0	0.30		6.7	6.0	3.2	8.33	102	24.6	46			
07/26	5.1			6.7			8.32	102	24.5	46			
07/26	6.0			6.7			8.35	102	24.4	46	0	0	
07/26	7.0			6.7			8.34	102	24.4	46			
07/26	8.0			6.66			10.54	114	18.3	46			
07/26	9.0			6.63			11.17	115	15.8	46			
07/26	10.0			6.59			11.36	114	14.7	46			
07/26	11.0			6.53			11.33	111	13.6	46			
07/26	12.0			6.51			11.38	110	13.0	46			
07/26	13.0			6.47			11.43	109	12.2	46			
07/26	14.0			6.41			11.23	106	11.9	46			
07/26	15.1			6.36			11.08	103	11.4	46			
07/26	16.0			6.31			10.97	101	11.1	46			
07/26	17.0			6.24			10.82	100	11.0	46			
07/26	18.0			6.19			10.58	97	10.8	46			
07/26	19.0			6.14			10.42	95	10.6	46			
07/26	20.0			6.09			10.4	95	10.5	46			

QUABBIN LABORATORY RECORDS 2006
(206) SHAFT #12 --- RESERVOIR

DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
07/26	21.0			6.05			10.21	93	10.3	46			
07/26	22.0	0.26		6.02	4.6	2.7	10.19	92	10.2	46			
07/26	23.0			5.99			10.04	91	10.0	46			
07/26	24.0			5.97			9.98	90	9.9	46	0	0	
07/26	25.0			5.96			10	90	9.8	46			
07/26	26.0			5.93			9.88	89	9.8	46			
07/26	27.0			5.92			9.77	88	9.7	46			
07/26	28.0			5.90			9.75	87	9.6	46			
07/26	29.0			5.88			9.6	85	9.3	47			
07/26	30.0			5.84			9.38	82	8.8	47			
07/26	31.0			5.82			9.4	81	8.2	47			
07/26	32.0			5.81			9.3	79	7.7	47			
07/26	33.0			5.78			9.14	78	7.5	47			
07/26	34.0			5.76			8.89	75	7.4	47			
07/26	35.0			5.74			8.67	73	7.3	47			
08/16	0.5		10.8	6.67			8.93	108	23.8	46	0	0	528.38
08/16	1.0	0.22		6.68	4.2	2.4	8.84	106	23.7	46			
08/16	2.0			6.69			8.68	104	23.7	46			
08/16	3.1			6.68			8.67	104	23.7	46			
08/16	4.0			6.68			8.6	103	23.7	46			
08/16	5.0			6.68			8.58	103	23.7	46			
08/16	6.0			6.67			8.46	102	23.6	46	0	3	
08/16	7.1			6.67			8.4	101	23.6	46			
08/16	8.0			6.67			8.34	100	23.6	46			
08/16	9.0			6.66			8.34	100	23.6	46			
08/16	10.0			6.64			9.56	109	21.1	46			
08/16	11.0			6.62			11.28	116	16.0	46			
08/16	12.0			6.55			11.45	115	14.8	46			
08/16	13.1			6.49			11.33	112	14.1	46			
08/16	14.0			6.45			11.41	111	13.2	46			
08/16	15.1			6.41			11.38	110	12.8	46			
08/16	16.0			6.33			11.07	105	12.1	46			
08/16	17.0			6.28			10.98	103	11.7	46			
08/16	18.0			6.22			10.75	100	11.5	46			
08/16	19.0			6.15			10.48	97	11.3	46			
08/16	20.1			6.1			10.21	94	11.1	46			
08/16	21.1			6.03			9.83	91	11.0	46			
08/16	22.1			5.97			9.74	89	10.7	46			
08/16	23.0			5.91			9.53	87	10.5	46			
08/16	24.0			5.87			9.34	85	10.2	47	0	19	
08/16	25.1			5.84			9.16	83	10.1	47			
08/16	26.0			5.8			9	81	10.0	47			

QUABBIN LABORATORY RECORDS 2006
(206) SHAFT #12 --- RESERVOIR

DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
08/16	26.9			5.78			8.84	80	10.0	47			
08/16	27.0			5.77			8.82	79	10.0	47			
08/16	28.2			5.75			8.74	79	9.9	47			
08/16	29.0			5.74			8.53	76	9.7	47			
08/16	30.0			5.71			8.15	72	9.3	47			
08/16	31.1			5.71			8.29	72	8.4	47			
08/16	32.0			5.67			8	69	8.0	47			
08/16	33.0			5.65			7.89	67	7.6	47			
08/16	34.0			5.62			7.63	65	7.4	47			
08/16	35.0	0.23		5.6	4.4	2.6	7.26	61	7.3	47			
08/16	36.1			5.56			6.66	56	7.2	48			
09/21	0.5		10.0	6.69			9.78	110	20.0	46	0	0	527.04
09/21	1.0			6.79			9.62	108	20.0	46			
09/21	2.1			6.71			9.55	107	20.0	46			
09/21	3.1			6.7			9.55	107	20.0	46			
09/21	4.0			6.69			9.53	107	20.0	46			
09/21	5.1			6.69			9.49	106	20.0	46			
09/21	6.0			6.69			9.43	106	20.0	46	0	0	
09/21	7.1			6.68			9.41	106	20.0	46			
09/21	8.1			6.69			9.32	105	20.0	46			
09/21	9.0			6.68			9.34	105	20.0	46			
09/21	10.1			6.68			9.28	104	20.0	46			
09/21	11.1			6.68			9.3	104	20.0	46			
09/21	12.0			6.66			9.32	104	19.5	46			
09/21	13.0			6.59			10.26	108	16.7	46			
09/21	14.0	0.30		6.51	6.6	3.4	10.4	106	15.4	46			
09/21	15.1			6.42			10.55	105	14.4	46			
09/21	16.1			6.36			10.72	104	13.2	46			
09/21	17.0			6.31			10.83	104	12.5	46			
09/21	18.1			6.19			10.61	101	12.2	46			
09/21	19.2			6.15			10.51	99	12.0	46			
09/21	20.2			6.08			9.95	93	11.5	46			
09/21	21.0			6.05			9.8	91	11.3	46			
09/21	22.0			6.01			9.62	89	11.1	46			
09/21	23.1			5.96			9.38	87	11.0	46			
09/21	24.1			5.92			9.05	83	10.7	46	0	0	
09/21	25.0			5.86			8.7	80	10.5	46			
09/21	26.1			5.83			8.46	77	10.4	46			
09/21	27.1			5.81			8.32	76	10.3	46			
09/21	28.1			5.76			8.01	73	10.3	47			
09/21	29.0			5.75			7.87	71	10.0	47			
09/21	30.0	0.61		5.69	6.9	3.3	6.89	61	9.3	47			

QUABBIN LABORATORY RECORDS 2006
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DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
09/21	31.1			5.64			6.78	59	8.3	47			
09/21	32.0			5.6			6.67	57	7.8	47			
09/21	33.1			5.57			6.56	56	7.7	47			
09/21	34.0			5.53			6.18	53	7.5	47			
09/21	35.1			5.51			5.81	49	7.4	47			
09/21	36.0			5.49			5.41	46	7.3	47			
09/21	37.0			5.48			5.02	42	7.3	48			
10/19	0.5	0.35	9.1	6.73	4.6	2.4	10.18	103	15.4	46	0	0	526.35
10/19	1.0			6.71			10.24	103	15.4	46			
10/19	2.1			6.69			10.14	102	15.4	46			
10/19	3.1			6.66			10.09	102	15.4	46			
10/19	4.0			6.64			10.1	102	15.3	46			
10/19	5.0			6.61			9.98	101	15.3	46			
10/19	6.0			6.59			10	101	15.3	46	0	0	
10/19	7.1			6.57			9.89	100	15.3	46			
10/19	8.1			6.55			9.93	100	15.3	46			
10/19	9.0			6.54			9.91	100	15.3	46			
10/19	10.1			6.53			9.86	99	15.3	46			
10/19	11.0			6.52			9.81	99	15.3	46			
10/19	12.1			6.5			9.66	97	15.3	46			
10/19	13.0			6.48			9.59	97	15.3	46			
10/19	14.0			6.47			9.59	97	15.3	46			
10/19	15.0			6.46			9.56	96	15.3	46			
10/19	16.0			6.45			9.52	96	15.3	46			
10/19	17.1			6.34			9.16	89	13.9	46			
10/19	18.0	0.31		6.19	4.5	2.6	8.66	82	12.6	47			
10/19	19.0			6.05			8.36	79	12.3	47			
10/19	20.0			5.91			8.05	75	11.9	47			
10/19	21.0			5.8			7.79	72	11.4	47			
10/19	22.1			5.74			7.61	70	11.2	47			
10/19	23.1			5.7			7.54	69	11.1	47			
10/19	24.0			5.67			7.51	69	11.1	47	0	0	
10/19	25.0			5.65			7.43	68	11.1	47			
10/19	26.0			5.63			7.3	67	11.0	47			
10/19	27.01			5.62			7.17	65.52	10.95	47			
10/19	28.0			5.6			6.87	62.65	10.85	47			
10/19	29.0			5.58			6.39	57.66	10.37	47			
10/19	30.1			5.57			6.2	54.81	9.49	47			
10/19	31.0			5.55			6.03	53	8.98	48			
10/19	32.0			5.53			5.97	51	8.37	48			
10/19	33.1	0.27		5.49	4.4	2.9	5.29	45	7.91	48			
11/15	0.5	0.28	10.2	6.18	5.5	3.0	11.64	110	11.60	46	0	0	527.04

QUABBIN LABORATORY RECORDS 2006
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DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
11/15	1.0			6.18			11.40	108	11.58	46			
11/15	2.0			6.19			11.21	106	11.58	46			
11/15	3.0			6.21			11.03	104	11.57	46			
11/15	4.0			6.21			10.93	103	11.57	46			
11/15	5.0			6.22			10.98	104	11.57	46			
11/15	6.0			6.22			10.97	104	11.57	46	0	0	
11/15	7.0			6.22			10.77	102	11.57	46			
11/15	8.0			6.23			10.80	102	11.57	46			
11/15	9.0			6.23			10.86	102	11.57	46			
11/15	10.0			6.23			10.78	102	11.57	46			
11/15	11.0			6.23			10.74	101	11.56	46			
11/15	12.0			6.23			10.71	101	11.56	46			
11/15	13.0			6.24			10.72	101	11.56	46			
11/15	14.0			6.23			10.59	100	11.56	46			
11/15	15.0			6.24			10.60	100	11.56	46			
11/15	16.0			6.24			10.64	100	11.53	46			
11/15	17.0			6.23			10.59	100	11.53	46			
11/15	18.1			6.23			10.61	100	11.53	46			
11/15	19.1			6.23			10.48	99	11.52	46			
11/15	20.1			6.23			10.49	99	11.53	46			
11/15	21.0			6.23			10.55	99	11.52	46			
11/15	22.0			6.23			10.49	99	11.52	46			
11/15	23.0			6.23			10.51	99	11.52	46			
11/15	24.1			6.23			10.42	98	11.51	46	0	1	
11/15	25.0			6.22			10.40	98	11.51	46			
11/15	26.0			6.22			10.37	98	11.47	46			
11/15	27.1			6.21			10.29	97	11.42	46			
11/15	28.1			6.19			10.15	95	11.41	46			
11/15	29.0			6.18			10.25	96	11.40	46			
11/15	30.1			6.16			10.03	94	11.33	46			
11/15	31.0			6.15			10.03	94	11.29	46			
11/15	32.1			6.13			9.97	93	11.23	46			
11/15	33.1	0.3		6.11	5.2	2.9	9.85	92	11.18	46			
11/15	34.1			5.96			7.98	70	8.72	48			
12/14	0.5	0.28	11.5	6.46	5.3	3.0	12.78	108	7.62	46	0	0	527.7
12/14	1.0			6.44			12.67	107	7.62	46			
12/14	3.0			6.41			12.56	106	7.63	46			
12/14	6.1			6.39			12.52	106	7.62	46	0	0	
12/14	9.0			6.37			12.56	106	7.61	46			
12/14	12.0			6.35			12.51	105	7.60	46			
12/14	15.0			6.34			12.39	104	7.61	46			
12/14	17.1	0.25		6.34	5.5	3.0	12.40	104	7.60	46			

QUABBIN LABORATORY RECORDS 2006
(206) SHAFT #12 --- RESERVOIR

DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
12/14	18.1			6.33			12.27	103	7.59	46			
12/14	21.0			6.33			12.30	104	7.59	46			
12/14	24.1			6.32			12.26	103	7.59	46	0	0	
12/14	27.0			6.31			12.31	104	7.58	46			
12/14	30.0			6.31			12.32	104	7.57	46			
12/14	32.9	0.26		6.30	5.5	3.1	12.28	103	7.58	46			
12/14	34.0			6.30			12.10	102	7.58	46			
	AVG.	**0.28**	**10.1**	**6.34**	**5.24**	**2.94**	**10.28**	**97.1**	**12.20**	**46**	**0**	**1**	
	MAX.	**0.61**	**12.2**	**7.73**	**6.87**	**3.46**	**15.09**	**125.6**	**24.95**	**48**	**0**	**19**	
	MIN.	**0.18**	**8.3**	**5.48**	**4.22**	**2.44**	**5.02**	**42.5**	**5.95**	**45**	**0**	**0**	
	MEDIAN	**0.27**	**10.1**	**6.33**	**5.19**	**2.95**	**10.25**	**101.7**	**11.20**	**46**	**0**	**0**	

QUABBIN LABORATORY RECORDS 2006
DEN HILL --- RESERVOIR

DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
04/20	0.5		4.0								0	0	529.95
04/20	1.0	0.34		7.25	4.8	3.1	12.33	112	10.1	51			
04/20	3.0			7.14			12.87	115	9.4	50			
04/20	6.0			7.04			12.84	113	8.8	50	0	0	
04/20	9.0			6.89			12.93	114	8.6	50			
04/20	12.0			6.8			12.77	112	8.6	50	0	0	
04/20	15.0			6.75			13.03	113	8.3	50			
04/20	18.0	0.30		6.72	4.5	2.9	13.23	112	7.3	50			
05/17	0.5	0.28	7.1	6.89	5.3	3.2	11.29	110	12.5	48	0	0	529.74
05/17	1.0			6.85			11.20	109	12.5	48			
05/17	3.0			6.83			11.3	109	12.0	48			
05/17	6.0			6.78			11.2	107	12.0	48	0	0	
05/17	9.0			6.7			12.06	108	9.2	46			
05/17	12.0			6.55			11.93	107	9.0	47	0	0	
05/17	15.1			6.5			11.73	105	8.9	47			
05/17	17.1			6.47			11.9	105	8.6	48			
05/17	18.1	0.25		6.41	5.1	2.7	11.68	103	8.6	48			
05/17	19.0			6.33			11.64	103	8.5	48			
06/21	0.5		7.1	7.08			8.57	101	22.64	48.0	0	0	529.98
06/21	1.0			7.07			8.82	102	21.9	47			
06/21	2.0			7.04			8.92	102	21.3	47			
06/21	3.0			7.02			9.07	102	20.4	47			
06/21	4.0			7			9.36	104	19.5	46			
06/21	5.0			6.99			9.63	105	18.5	46			
06/21	6.0	0.39		6.97	6.4	3.4	9.84	106	18.1	46	0	0	
06/21	7.0			6.93			9.88	104	16.8	47			
06/21	8.1			6.86			10.08	104	15.9	47			
06/21	9.1			6.84			10.35	104	14.7	46			
06/21	10.0			6.79			10.7	105	13.7	46			
06/21	11.1			6.75			11.16	106	12.2	47			
06/21	12.0			6.64			11.03	103	11.6	47			
06/21	13.1	0.33		6.59	6.5	3.5	10.82	99	10.8	47	0	0	
06/21	14.0			6.44			10.42	94	10.2	47			
06/21	15.0			6.34			10.22	92	10.1	47			
06/21	16.0			6.3			10.36	93	9.8	47			
06/21	17.1			6.24			10.22	91	9.5	47			
06/21	18.0			6.14			9.88	88	9.3	48			
06/21	19.0			6.07			9.67	85	9.1	48			
07/26	0.5		6.7	6.72			8.71	109	25.8	48	0	0	529.44
07/26	1.0			6.71			8.59	107	25.7	48			
07/26	2.0			6.71			8.59	106	25.2	47			
07/26	3.0	0.32		6.7	5.3	3.3	8.55	105	25.0	47			

QUABBIN LABORATORY RECORDS 2006
DEN HILL --- RESERVOIR

DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
07/26	4.0			6.68			8.46	104	24.8	47			
07/26	5.0			6.66			8.44	103	24.6	47			
07/26	6.0			6.63			8.39	103	24.6	47	0	1	
07/26	7.0			6.5			8.19	96	22.5	47			
07/26	8.0			6.41			8.35	97	21.9	47			
07/26	9.0			6.29			8.32	94	20.6	47			
07/26	10.0			6.1			8.04	86	17.7	48			
07/26	11.0			5.97			8.31	85	15.7	48			
07/26	12.1	0.34		5.93	5.0	3.0	8.75	86	13.7	48			
07/26	13.0			5.87			8.33	80	12.8	48	0	0	
07/26	14.0			5.82			7.98	75	11.7	48			
07/26	15.1			5.81			8.41	78	11.0	48			
07/26	16.0			5.79			8.42	77	10.5	48			
07/26	17.0			5.76			7.87	72	10.3	49			
07/26	18.1			5.73			7.88	71	9.9	49			
08/16	0.5		6.0	6.66			8.4	103	24.6	48	0	0	528.38
08/16	1.0	0.42		6.64	4.9	2.9	8.35	102	24.6	48			
08/16	2.0			6.61			8.3	101	24.4	48			
08/16	3.0			6.6			8.3	101	24.3	48			
08/16	4.0			6.59			8.23	100	24.2	48			
08/16	5.0			6.56			8.14	99	24.1	48			
08/16	6.0			6.54			8.08	98	24.1	48	0	0	
08/16	7.0			6.53			8.05	98	24.1	48			
08/16	8.0			6.5			7.96	96	24.0	48			
08/16	9.0			6.39			7.85	92	22.3	47			
08/16	10.0			6.18			7.31	81	19.4	47			
08/16	11.0			5.95			7.56	79	16.4	48			
08/16	12.0			5.88			7.91	79	14.4	48			
08/16	13.0			5.8			8.02	78	13.3	48	0	2	
08/16	14.0			5.75			7.87	75	12.3	48			
08/16	15.0			5.55			5.7	53	11.4	49			
08/16	16.0			5.58			6	55	10.7	49			
08/16	17.0			5.57			6	55	10.4	49			
08/16	18.0	0.42		5.57	5.0	3.0	5.88	53	10.0	49			
09/21	0.5		8.7	6.61			8.56	96	20.2	47	0	0	527.04
09/21	1.1			6.6			8.6	97	20.2	47			
09/21	2.0			6.58			8.62	97	20.2	47			
09/21	3.0			6.58			8.65	97	20.2	47			
09/21	4.0			6.58			8.63	97	20.2	47			
09/21	5.0			6.57			8.63	97	20.2	47			
09/21	6.0			6.56			8.65	97	20.1	47	0	0	
09/21	7.0			6.55			8.64	97	20.1	47			

QUABBIN LABORATORY RECORDS 2006
DEN HILL --- RESERVOIR

DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
09/21	8.0			6.54			8.59	97	20.1	47			
09/21	9.1			6.53			8.51	96	20.1	47			
09/21	10.1			6.52			8.52	96	20.1	47			
09/21	11.0			6.44			8.05	89	19.4	47			
09/21	12.1			6.25			7.66	84	19.0	47			
09/21	13.0	0.41		5.99	7.2	3.5	6.61	67	15.4	48	0	0	
09/21	14.1			5.89			5.87	57	13.1	49			
09/21	15.0			5.76			4.52	43	12.1	49			
09/21	16.1	1.01		5.72	7.4	3.9	4.24	39	10.8	49			
09/21	17.0			5.65			3.90	36	10.4	49			
09/21	18.0			5.59			3.33	30	10.0	50			
10/19	0.5	0.41	7.8	6.93	5.0	2.8	10.28	103	15.2	47	0	0	526.35
10/19	1.0			6.84			9.99	100	15.2	47			
10/19	2.0			6.78			9.86	99	15.1	47			
10/19	3.1			6.72			9.78	98	15.0	47			
10/19	4.0			6.67			9.74	97	14.9	47			
10/19	5.1			6.61			9.69	97	14.9	47			
10/19	6.1			6.57			9.57	96	14.9	47	0	0	
10/19	7.1			6.54			9.46	94	14.9	47			
10/19	8.1			6.5			9.38	94	14.9	47			
10/19	9.1			6.45			9.39	94	14.8	47			
10/19	10.0			6.43			9.42	94	14.8	47			
10/19	11.0			6.41			9.49	94	14.8	48			
10/19	12.0			6.39			9.48	94	14.7	48			
10/19	13.1			6.36			9.38	93	14.5	48	0	0	
10/19	14.1			6.34			9.34	92	14.5	48			
10/19	15.0			6.28			9.05	89	14.2	48			
10/19	16.0	0.58		6.18	5.0	3.3	8.52	83	14.0	48			
10/19	17.08			5.8			3.72	34.54	11.64	50			
10/19	18.05			5.61			2.17	19.7	10.67	50			
11/15	0.5	0.4	8.4	6.2	5.82	3.52	12.03	111.74	10.88	47	0	0	527.04
11/15	1.0			6.23			11.75	109	10.88	47			
11/15	2.0			6.26			11.62	108	10.87	47			
11/15	3.0			6.28			11.44	106	10.84	47			
11/15	4.0			6.29			11.45	106	10.80	47			
11/15	5.0			6.30			11.36	105	10.78	47			
11/15	5.9			6.29			11.33	105	10.76	47	0	0	
11/15	7.0			6.30			11.23	104	10.76	47			
11/15	8.0			6.30			11.21	104	10.75	47			
11/15	9.0			6.31			11.17	103	10.74	47			
11/15	10.0			6.31			11.07	102	10.72	47			
11/15	11.0			6.31			11.06	102	10.70	47			

QUABBIN LABORATORY RECORDS 2006
DEN HILL --- RESERVOIR

DATE	DEPTH-M	TURB	Secchi	pH (Field)	STDALK	EPAALK	DOPPM	DOSAT	TEMPC	SPCOND	ECOLI	FECCOLI	ELEV
11/15	12.0			6.31			10.97	101	10.65	47			
11/15	13.0			6.31			11.06	102	10.63	47			
11/15	14.0			6.31			10.90	101	10.62	47			
11/15	15.0			6.30			10.85	100	10.56	47			
11/15	16.0			6.29			10.88	100	10.45	48			
11/15	17.0			6.27			10.73	98	10.31	49			
11/15	18.0	0.47		6.25	6.1	3.6	10.56	97	10.21	49	0	1	
11/15	19.0			6.20			10.29	94	10.07	50			
12/14	0.5	0.39	7.0	6.70	5.9	3.4	14.13	116	6.44	48	0	0	527.7
12/14	1.0			6.63			13.69	112	6.43	48			
12/14	3.0			6.58			13.33	109	6.37	48			
12/14	6.0			6.48			13.09	107	6.29	48	0	0	
12/14	9.0	0.38		6.42	5.9	3.4	12.95	105	6.24	48			
12/14	12.0			6.37			12.69	103	6.23	48			
12/14	15.0			6.35			12.84	104	5.88	49			
12/14	18.0	0.41		6.33	5.8	3.3	12.91	103	5.52	49	0	0	
12/14	19.1			6.30			12.72	102	5.52	49			
	AVG.	**0.41**	**7.0**	**6.42**	**5.63**	**3.24**	**9.54**	**94**	**14.40**	**48**	**0**	**<1**	
	MAX.	**1.01**	**8.7**	**7.25**	**7.37**	**3.93**	**14.13**	**116**	**25.84**	**51**	**0**	**2**	
	MIN.	**0.25**	**4.0**	**5.55**	**4.52**	**2.67**	**2.17**	**20**	**5.52**	**46**	**0**	**0**	
	MEDIAN	**0.39**	**7.1**	**6.45**	**5.29**	**3.32**	**9.44**	**99**	**12.64**	**48**	**0**	**0**	